FIG.1

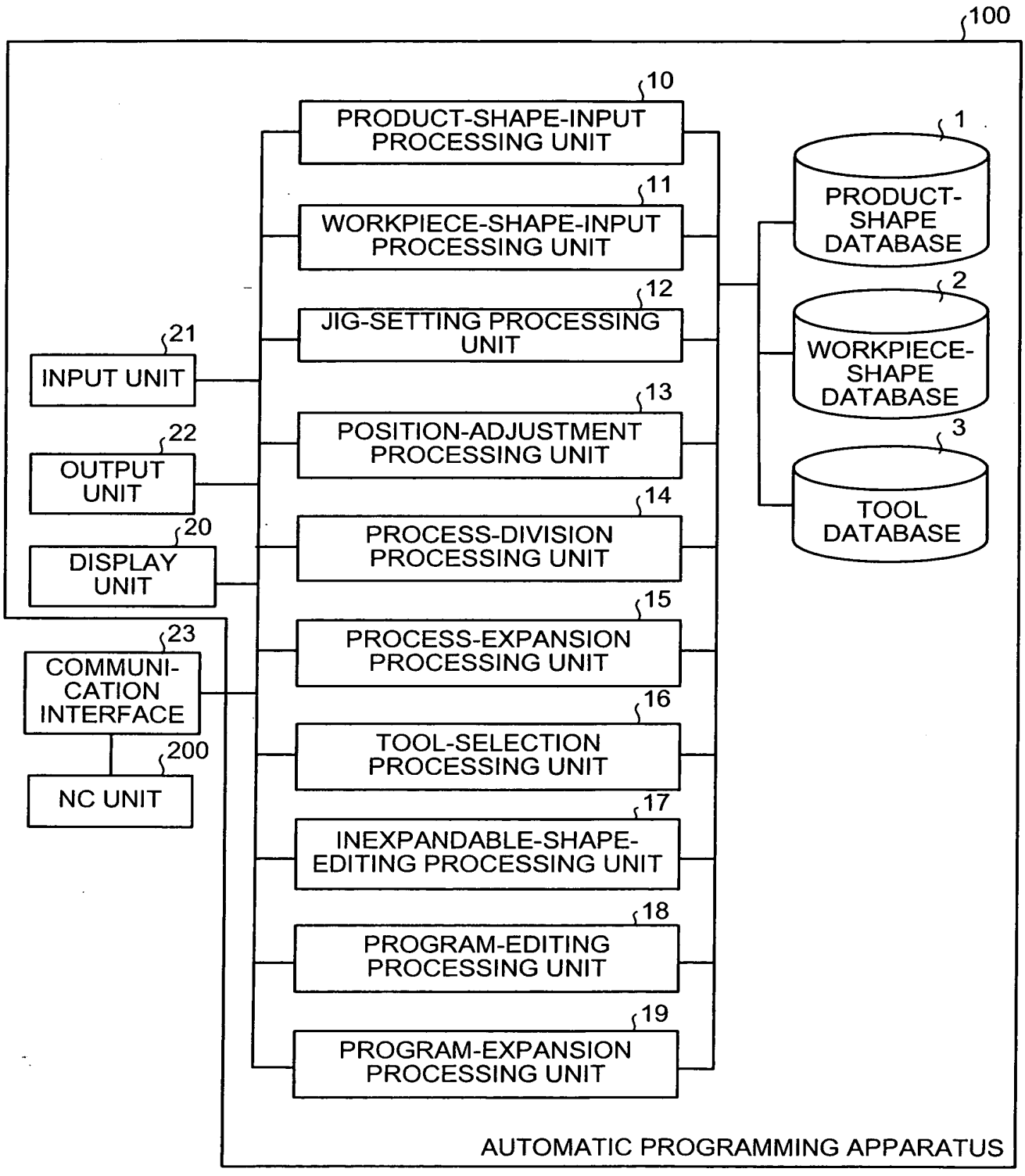
100
10
PRODUCT-SHAPE-INPUT PROCESSING UNIT
11
WORKPIECE-SHAPE-INPUT PROCESSING UNIT
12
JIG-SETTING PROCESSING UNIT
13
POSITION-ADJUSTMENT PROCESSING UNIT
14
PROCESS-DIVISION PROCESSING UNIT
15
PROCESS-EXPANSION PROCESSING UNIT
16
TOOL-SELECTION PROCESSING UNIT
17
INEXPANDABLE-SHAPE-EDITING PROCESSING UNIT
18
PROGRAM-EDITING PROCESSING UNIT
19
PROGRAM-EXPANSION PROCESSING UNIT
1
PRODUCT-SHAPE DATABASE
2
WORKPIECE-SHAPE DATABASE
3
TOOL DATABASE
21
INPUT UNIT
22
OUTPUT UNIT
20
DISPLAY UNIT
23
COMMUNI-CATION INTERFACE
200
NC UNIT
AUTOMATIC PROGRAMMING APPARATUS

FIG.2

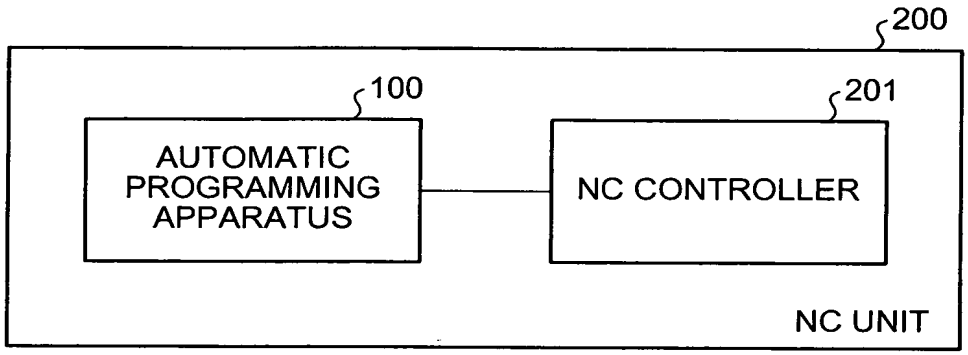
200
100
201
AUTOMATIC PROGRAMMING APPARATUS
NC CONTROLLER
NC UNIT

FIG.3

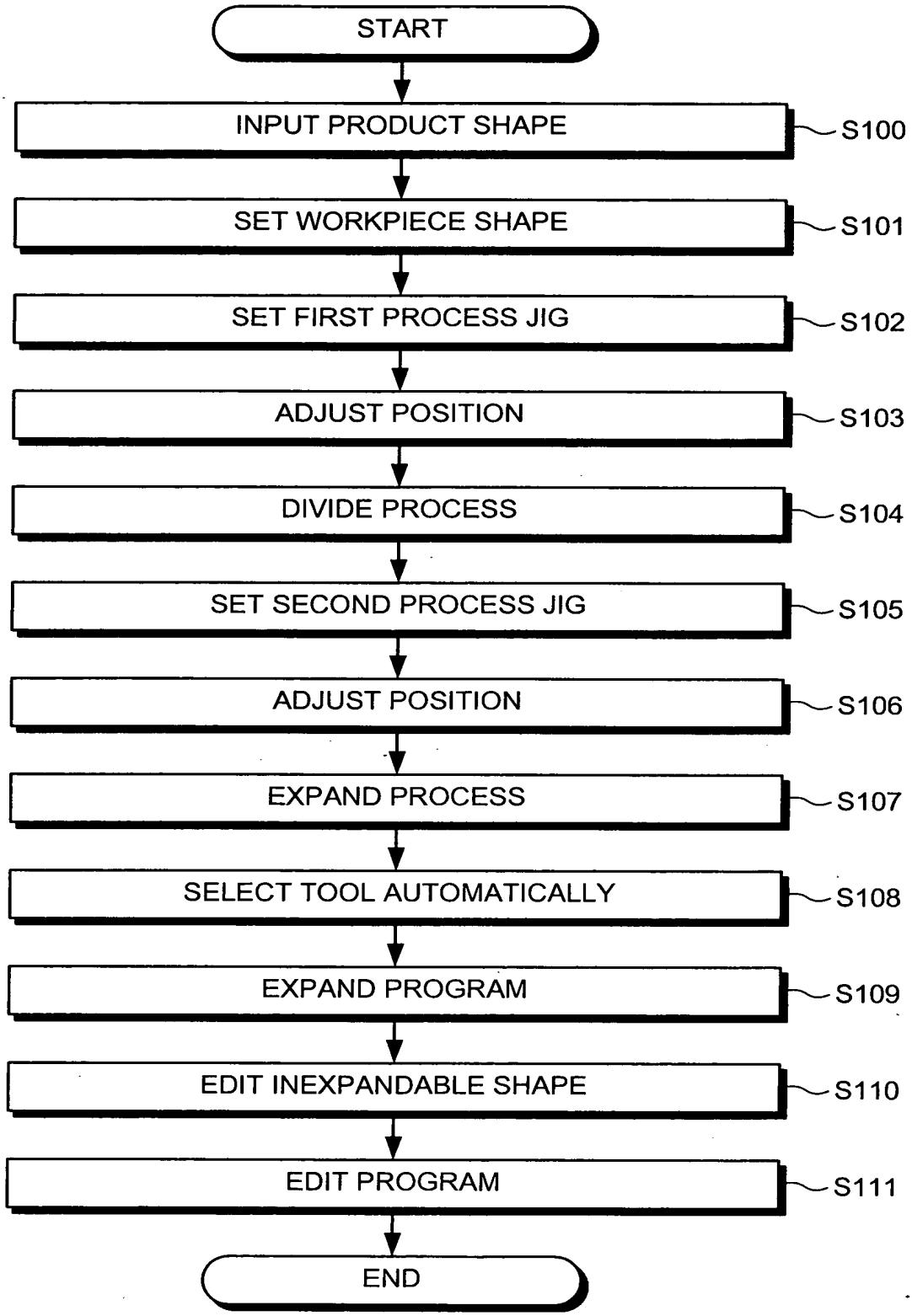
START
INPUT PRODUCT SHAPE
S100
SET WORKPIECE SHAPE
S101
SET FIRST PROCESS JIG
S102
ADJUST POSITION
S103
DIVIDE PROCESS
S104
SET SECOND PROCESS JIG
S105
ADJUST POSITION
S106
EXPAND PROCESS
S107
SELECT TOOL AUTOMATICALLY
S108
EXPAND PROGRAM
S109
EDIT INEXPANDABLE SHAPE
S110
EDIT PROGRAM
S111
END

FIG.4

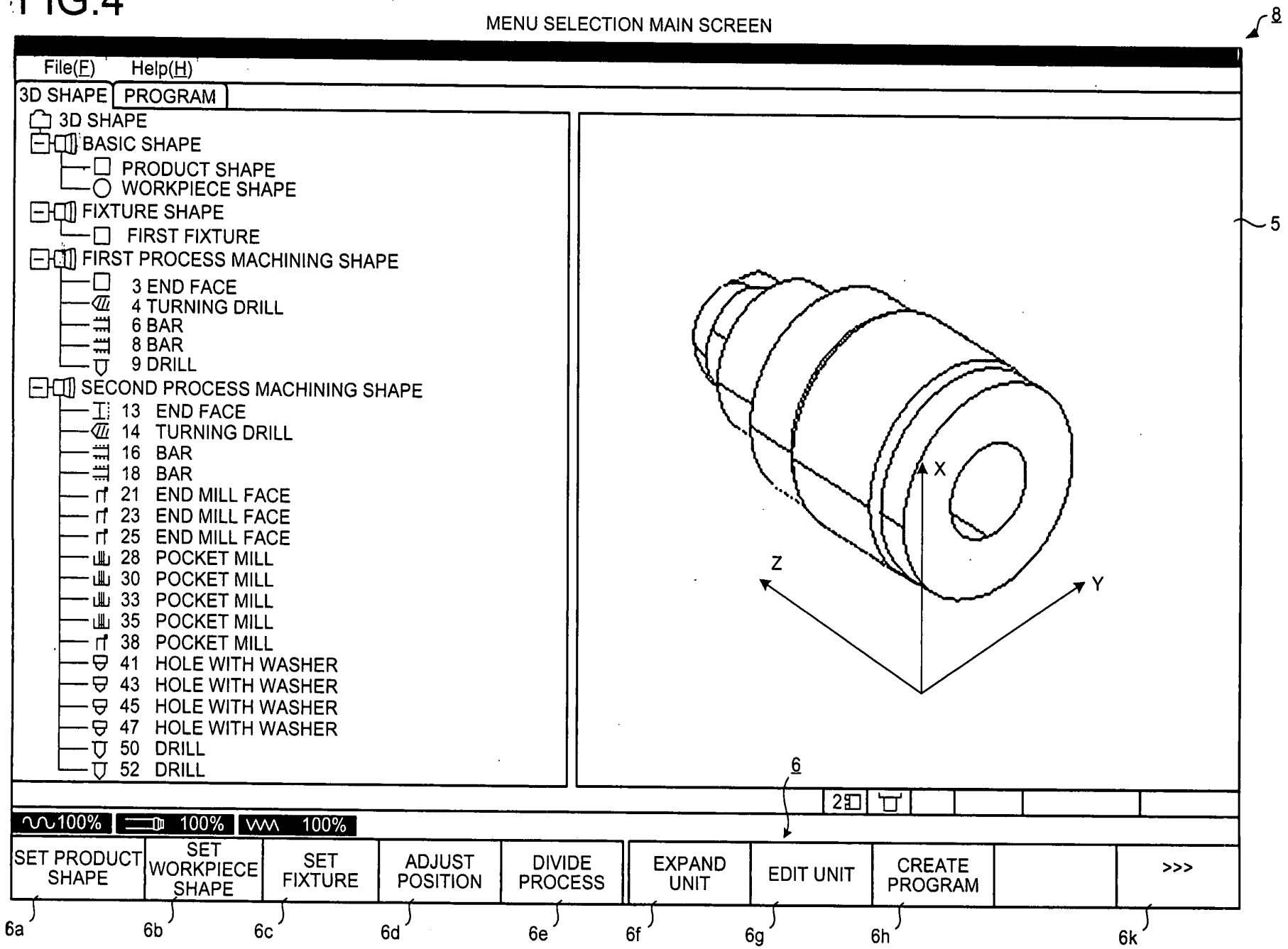


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FIG.5

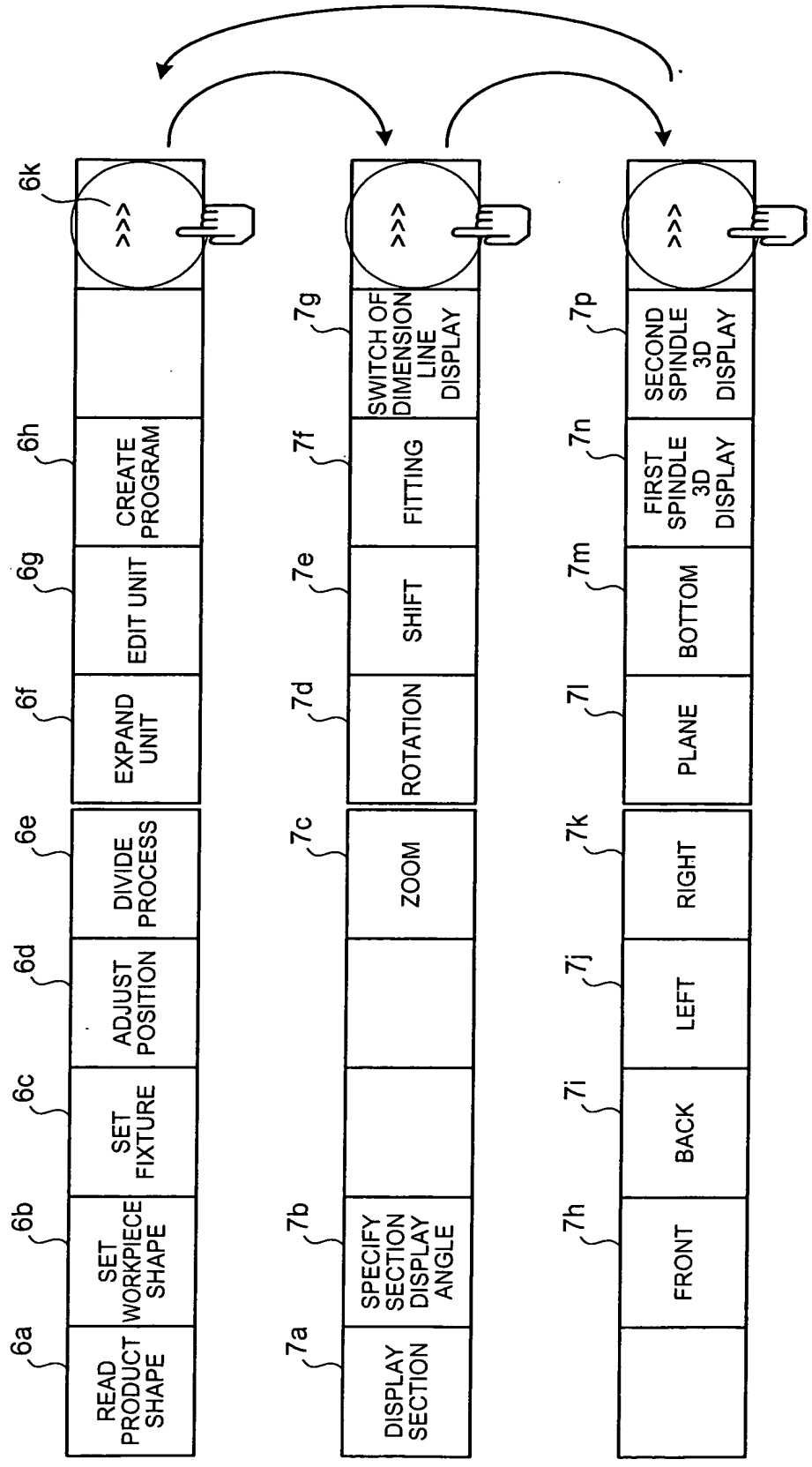

6k
>>>
6h
CREATE PROGRAM
6g
EDIT UNIT
6f
EXPAND UNIT
6e
DIVIDE PROCESS
6d
ADJUST POSITION
6c
SET FIXTURE
6b
SET WORKPIECE SHAPE
6a
READ PRODUCT SHAPE
7g
SWITCH OF DIMENSION LINE DISPLAY
7f
FITTING
7e
SHIFT
7d
ROTATION
7c
ZOOM
7b
SPECIFY SECTION DISPLAY ANGLE
7a
DISPLAY SECTION
7p
SECOND SPINDLE 3D DISPLAY
7n
FIRST SPINDLE 3D DISPLAY
7m
BOTTOM
7l
PLANE
7k
RIGHT
7j
LEFT
7i
BACK
7h
FRONT

FIG.6

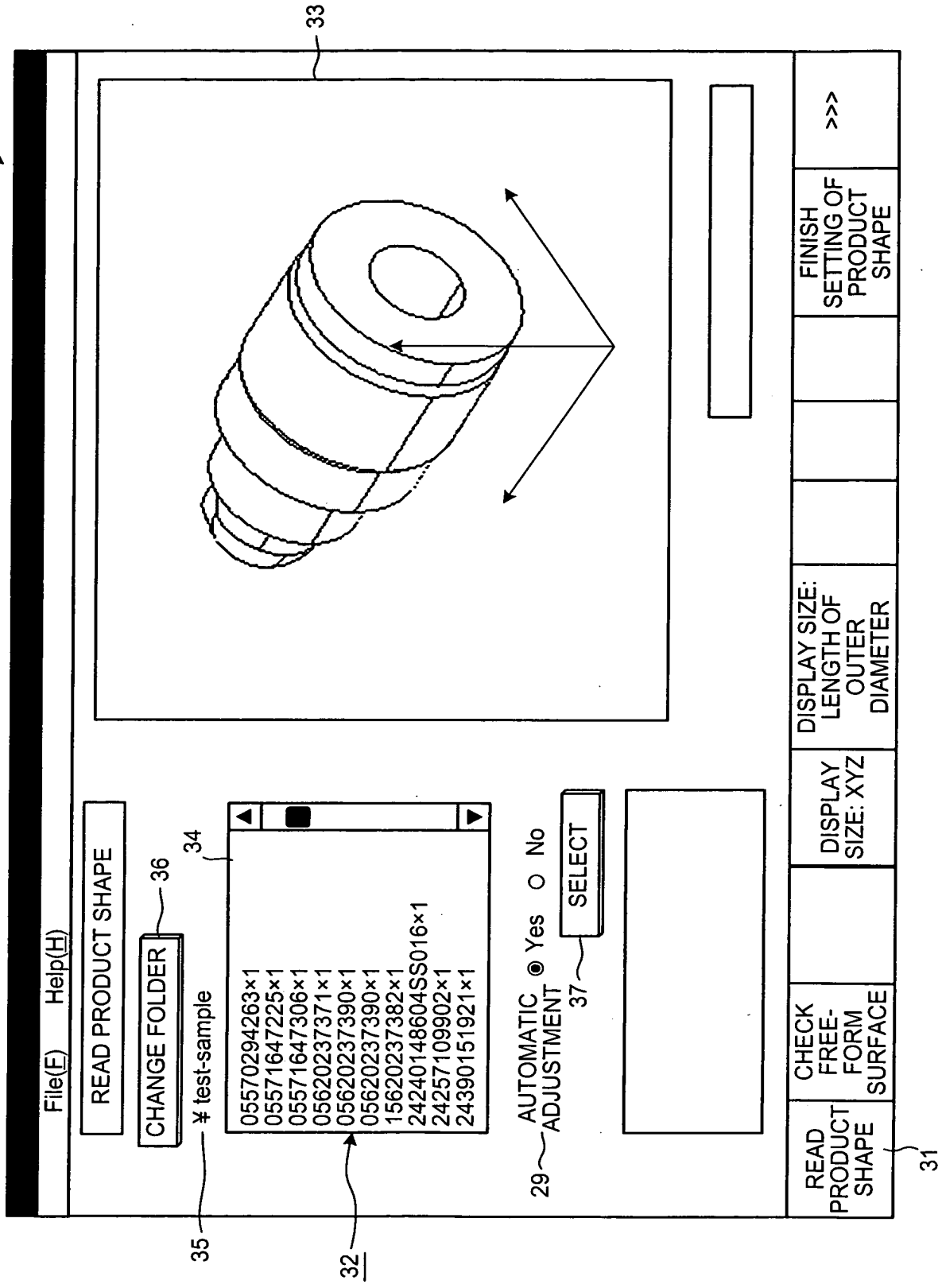
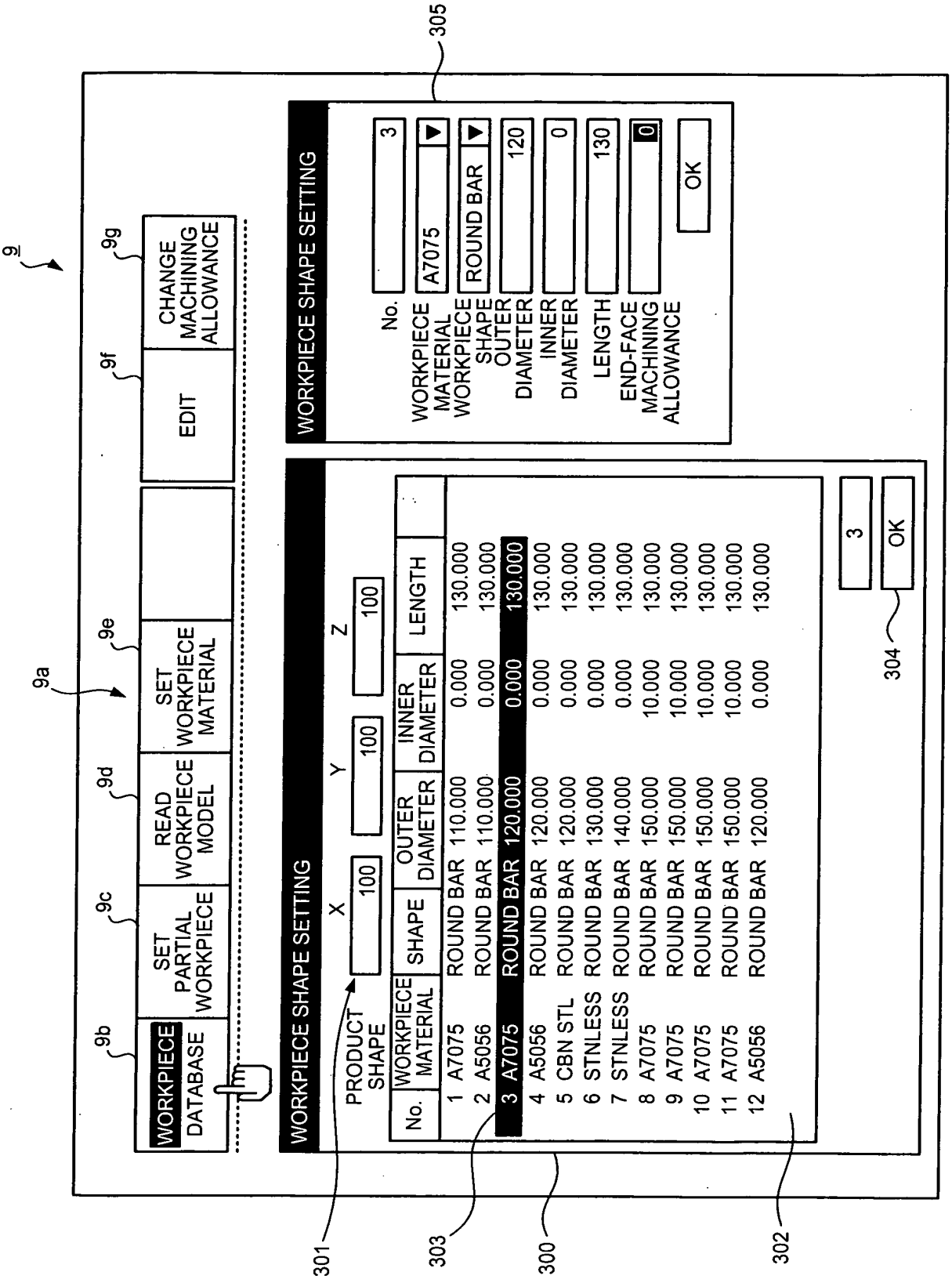

30
33
File(F)
Help(H)
READ PRODUCT SHAPE
CHANGE FOLDER
36
¥ test-sample
35
34
05570294263×1
05571647225×1
05571647306×1
05620237371×1
05620237390×1
05620237390×1
05620237382×1
24240148604SS016×1
24257109902×1
24390151921×1
32
AUTOMATIC ADJUSTMENT
Yes
No
SELECT
37
29
READ PRODUCT SHAPE
CHECK FREE-FORM SURFACE
DISPLAY SIZE: XYZ
DISPLAY SIZE: LENGTH OF OUTER DIAMETER
FINISH SETTING OF PRODUCT SHAPE
>>>
31

FIG.7


9
9a
9b
WORKPIECE DATABASE
9c
SET PARTIAL WORKPIECE
9d
READ WORKPIECE MODEL
9e
SET WORKPIECE MATERIAL
9f
EDIT
9g
CHANGE MACHINING ALLOWANCE
WORKPIECE SHAPE SETTING
PRODUCT SHAPE
X 100
Y 100
Z 100
No. | WORKPIECE MATERIAL | SHAPE | OUTER DIAMETER | INNER DIAMETER | LENGTH
1 A7075 ROUND BAR 110.000 0.000 130.000
2 A5056 ROUND BAR 110.000 0.000 130.000
3 A7075 ROUND BAR 120.000 0.000 130.000
4 A5056 ROUND BAR 120.000 0.000 130.000
5 CBN STL ROUND BAR 120.000 0.000 130.000
6 STNLESS ROUND BAR 130.000 0.000 130.000
7 STNLESS ROUND BAR 140.000 0.000 130.000
8 A7075 ROUND BAR 150.000 10.000 130.000
9 A7075 ROUND BAR 150.000 10.000 130.000
10 A7075 ROUND BAR 150.000 10.000 130.000
11 A7075 ROUND BAR 150.000 10.000 130.000
12 A5056 ROUND BAR 120.000 0.000 130.000
3
OK
304
305
WORKPIECE SHAPE SETTING
No. 3
WORKPIECE MATERIAL A7075
WORKPIECE SHAPE ROUND BAR
OUTER DIAMETER 120
INNER DIAMETER 0
LENGTH 130
END-FACE MACHINING ALLOWANCE 0
OK
301
303
300
302

# FIG.8

WORKPIECE SHAPE

| MATERIAL | SHAPE | OUTER DIAMETER | INNER DIAMETER | . . . . . |
|---|---|---|---|---|
| CBN STL | Cylinder | 250 | 20 | |
| CBN STL | Cylinder | 250 | 30 | |
| CBN STL | Cylinder | 250 | 40 | |
| CBN STL | Cylinder | 250 | 50 | |
| CBN STL | Cylinder | 400 | | |
| CBN STL | Cylinder | 400 | 30 | |
| CBN STL | Cylinder | 500 | | |
| CBN STL | Cylinder | 800 | 70 | |
| CBN STL | Cylinder | 800 | 100 | |
| CBN STL | Hexagon | 300 | | |
| CBN STL | Hexagon | 300 | | |
| CBN STL | Hexagon | 400 | | |

FIG.9

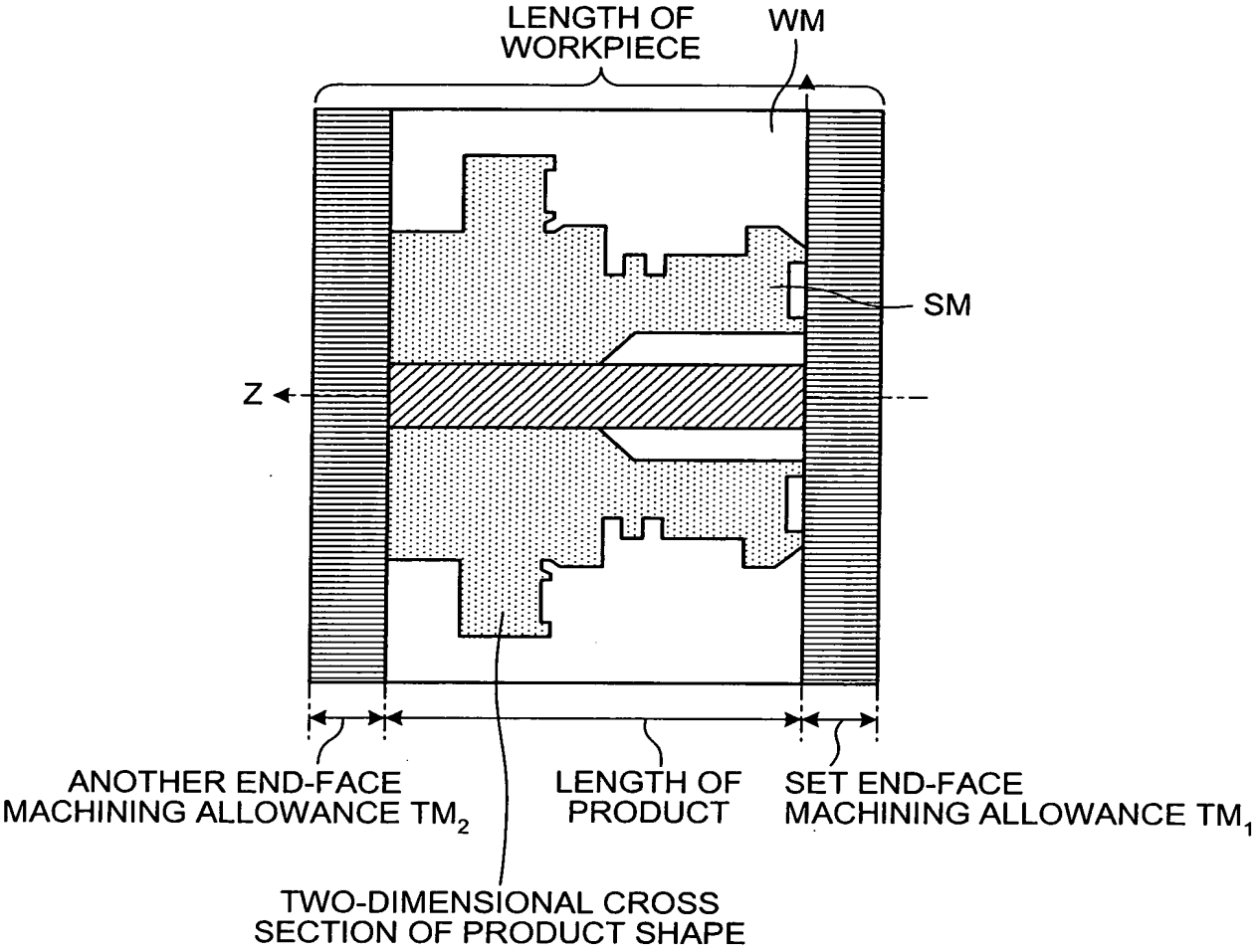

LENGTH OF WORKPIECE
WM
SM
Z
ANOTHER END-FACE MACHINING ALLOWANCE $TM_2$
LENGTH OF PRODUCT
SET END-FACE MACHINING ALLOWANCE $TM_1$
TWO-DIMENSIONAL CROSS SECTION OF PRODUCT SHAPE

FIG.10

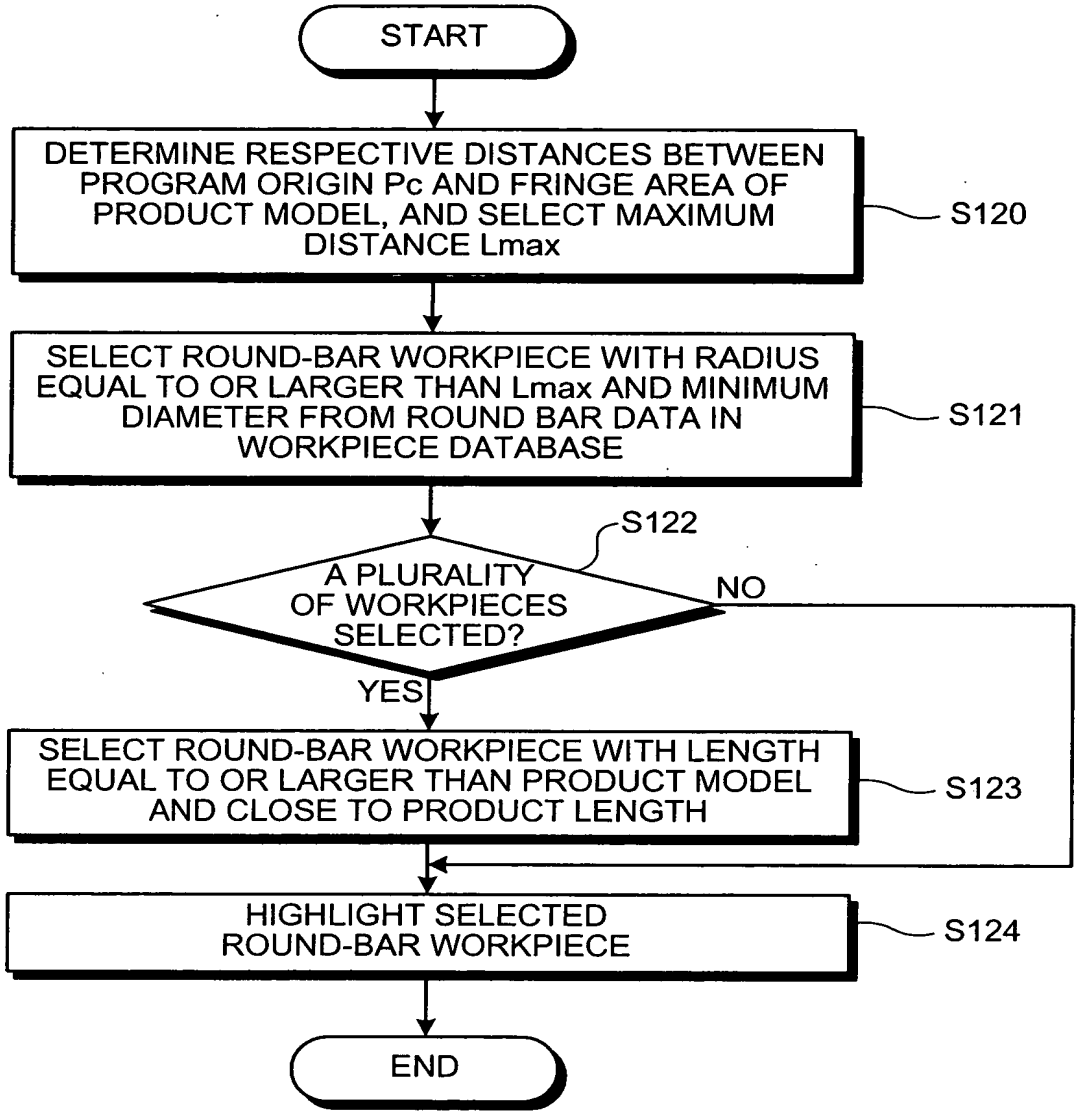

START
DETERMINE RESPECTIVE DISTANCES BETWEEN PROGRAM ORIGIN Pc AND FRINGE AREA OF PRODUCT MODEL, AND SELECT MAXIMUM DISTANCE Lmax
S120
SELECT ROUND-BAR WORKPIECE WITH RADIUS EQUAL TO OR LARGER THAN Lmax AND MINIMUM DIAMETER FROM ROUND BAR DATA IN WORKPIECE DATABASE
S121
S122
A PLURALITY OF WORKPIECES SELECTED?
NO
YES
SELECT ROUND-BAR WORKPIECE WITH LENGTH EQUAL TO OR LARGER THAN PRODUCT MODEL AND CLOSE TO PRODUCT LENGTH
S123
HIGHLIGHT SELECTED ROUND-BAR WORKPIECE
S124
END

FIG.11

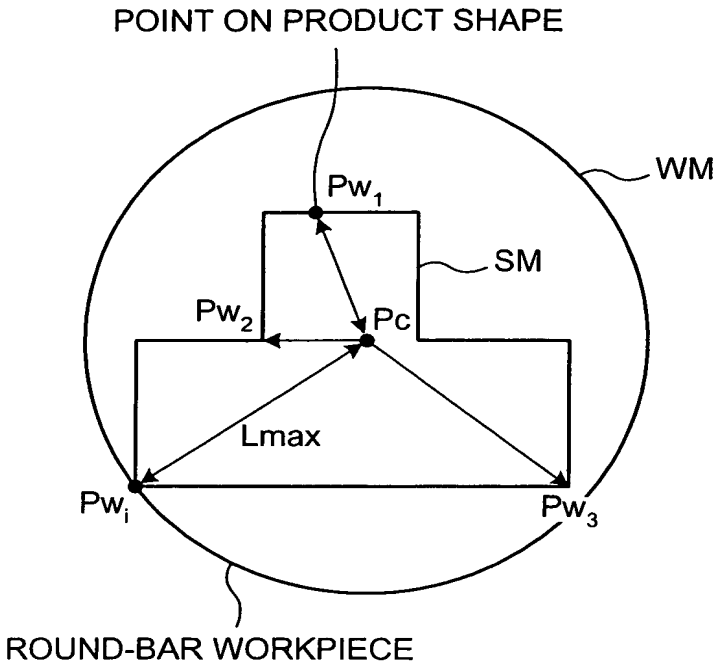

POINT ON PRODUCT SHAPE
WM
$Pw_1$
SM
$Pw_2$
Pc
Lmax
$Pw_i$
$Pw_3$
ROUND-BAR WORKPIECE

FIG.12

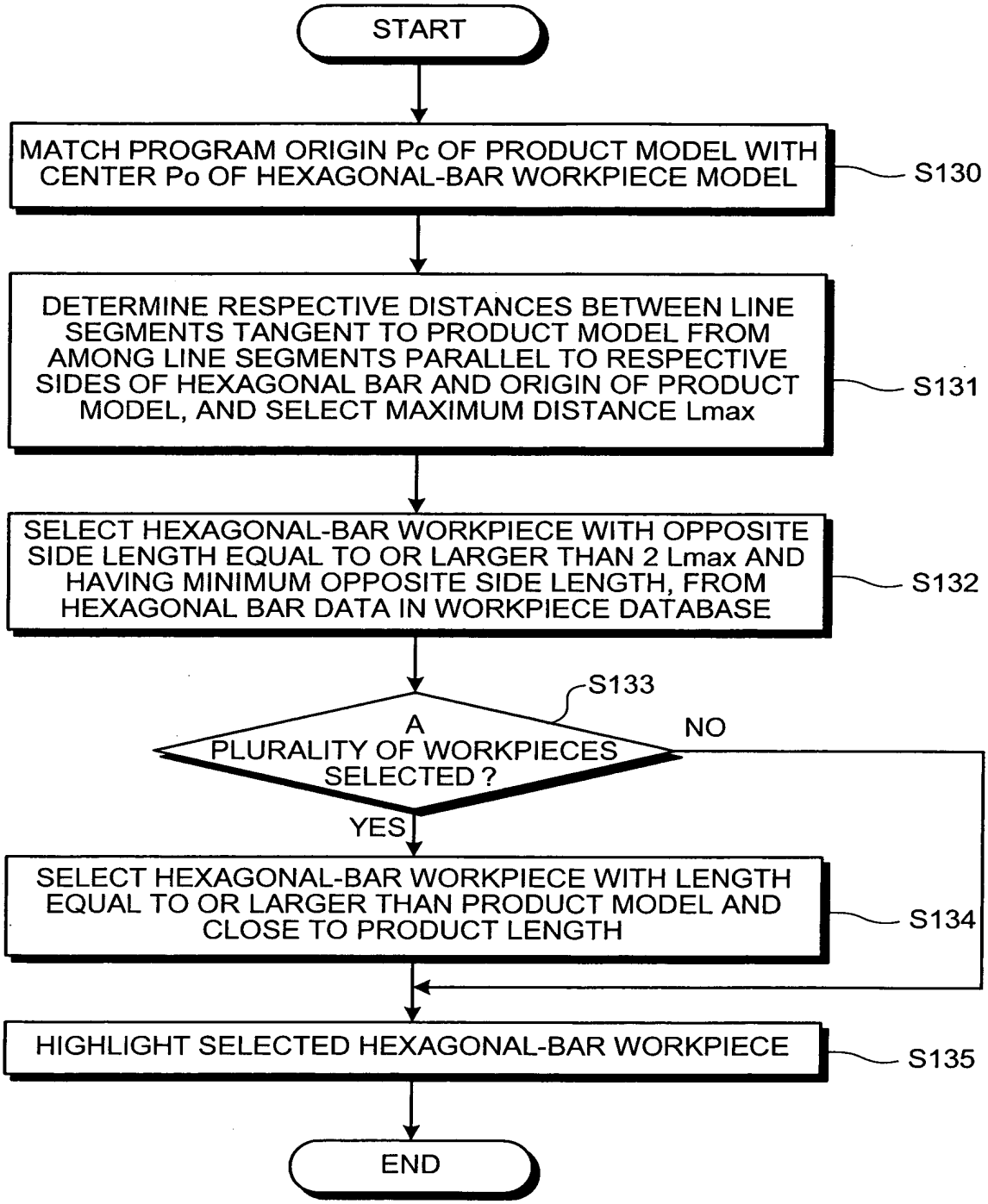

START
MATCH PROGRAM ORIGIN Pc OF PRODUCT MODEL WITH CENTER Po OF HEXAGONAL-BAR WORKPIECE MODEL
S130
DETERMINE RESPECTIVE DISTANCES BETWEEN LINE SEGMENTS TANGENT TO PRODUCT MODEL FROM AMONG LINE SEGMENTS PARALLEL TO RESPECTIVE SIDES OF HEXAGONAL BAR AND ORIGIN OF PRODUCT MODEL, AND SELECT MAXIMUM DISTANCE Lmax
S131
SELECT HEXAGONAL-BAR WORKPIECE WITH OPPOSITE SIDE LENGTH EQUAL TO OR LARGER THAN 2 Lmax AND HAVING MINIMUM OPPOSITE SIDE LENGTH, FROM HEXAGONAL BAR DATA IN WORKPIECE DATABASE
S132
S133
A PLURALITY OF WORKPIECES SELECTED ?
NO
YES
SELECT HEXAGONAL-BAR WORKPIECE WITH LENGTH EQUAL TO OR LARGER THAN PRODUCT MODEL AND CLOSE TO PRODUCT LENGTH
S134
HIGHLIGHT SELECTED HEXAGONAL-BAR WORKPIECE
S135
END

FIG.13

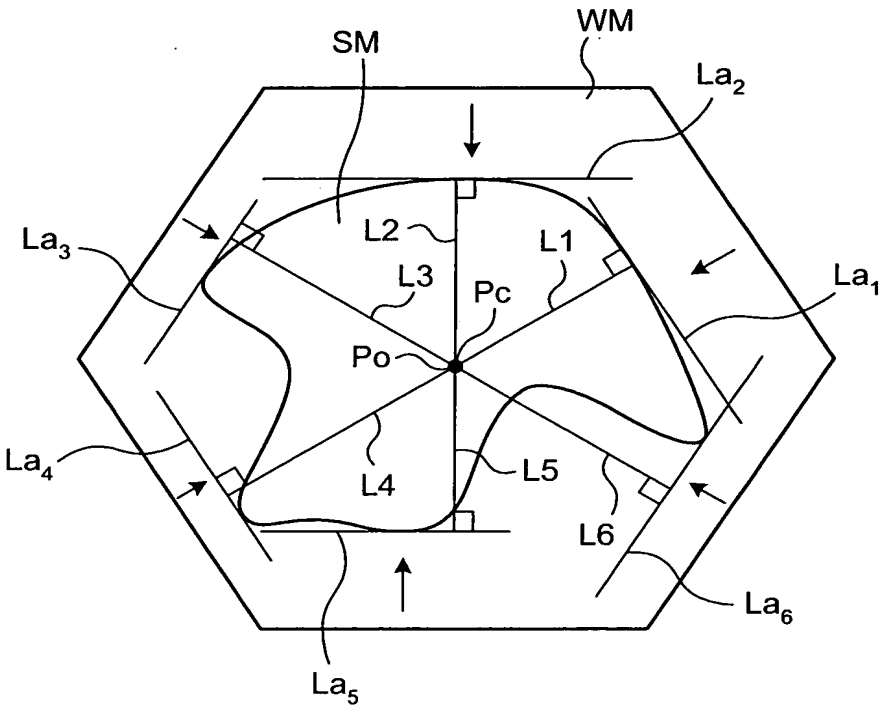


FIG.14

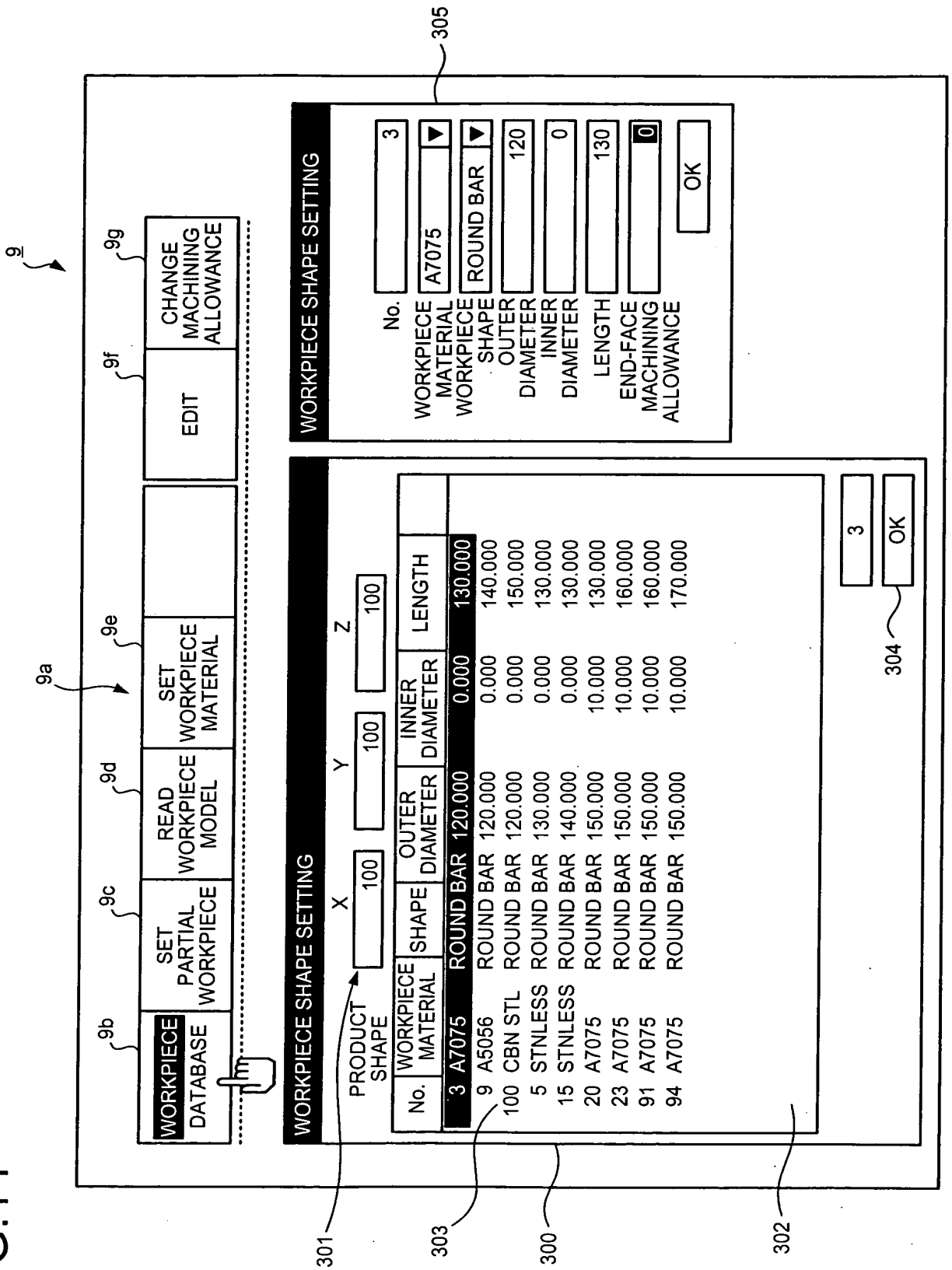

9
9a
9b
WORKPIECE DATABASE
9c
SET PARTIAL WORKPIECE
9d
READ WORKPIECE MODEL
9e
SET WORKPIECE MATERIAL
9f
EDIT
9g
CHANGE MACHINING ALLOWANCE
305
WORKPIECE SHAPE SETTING
No. 3
WORKPIECE MATERIAL A7075
WORKPIECE SHAPE ROUND BAR
OUTER DIAMETER 120
INNER DIAMETER 0
LENGTH 130
END-FACE MACHINING ALLOWANCE 0
OK
WORKPIECE SHAPE SETTING
PRODUCT SHAPE
X 100
Y 100
Z 100
No. | WORKPIECE MATERIAL | SHAPE | OUTER DIAMETER | INNER DIAMETER | LENGTH
3 A7075 ROUND BAR 120.000 0.000 130.000
9 A5056 ROUND BAR 120.000 0.000 140.000
100 CBN STL ROUND BAR 120.000 0.000 150.000
5 STNLESS ROUND BAR 130.000 0.000 130.000
15 STNLESS ROUND BAR 140.000 0.000 130.000
20 A7075 ROUND BAR 150.000 10.000 130.000
23 A7075 ROUND BAR 150.000 10.000 160.000
91 A7075 ROUND BAR 150.000 10.000 160.000
94 A7075 ROUND BAR 150.000 10.000 170.000
3
OK
304
301
303
300
302

FIG.15

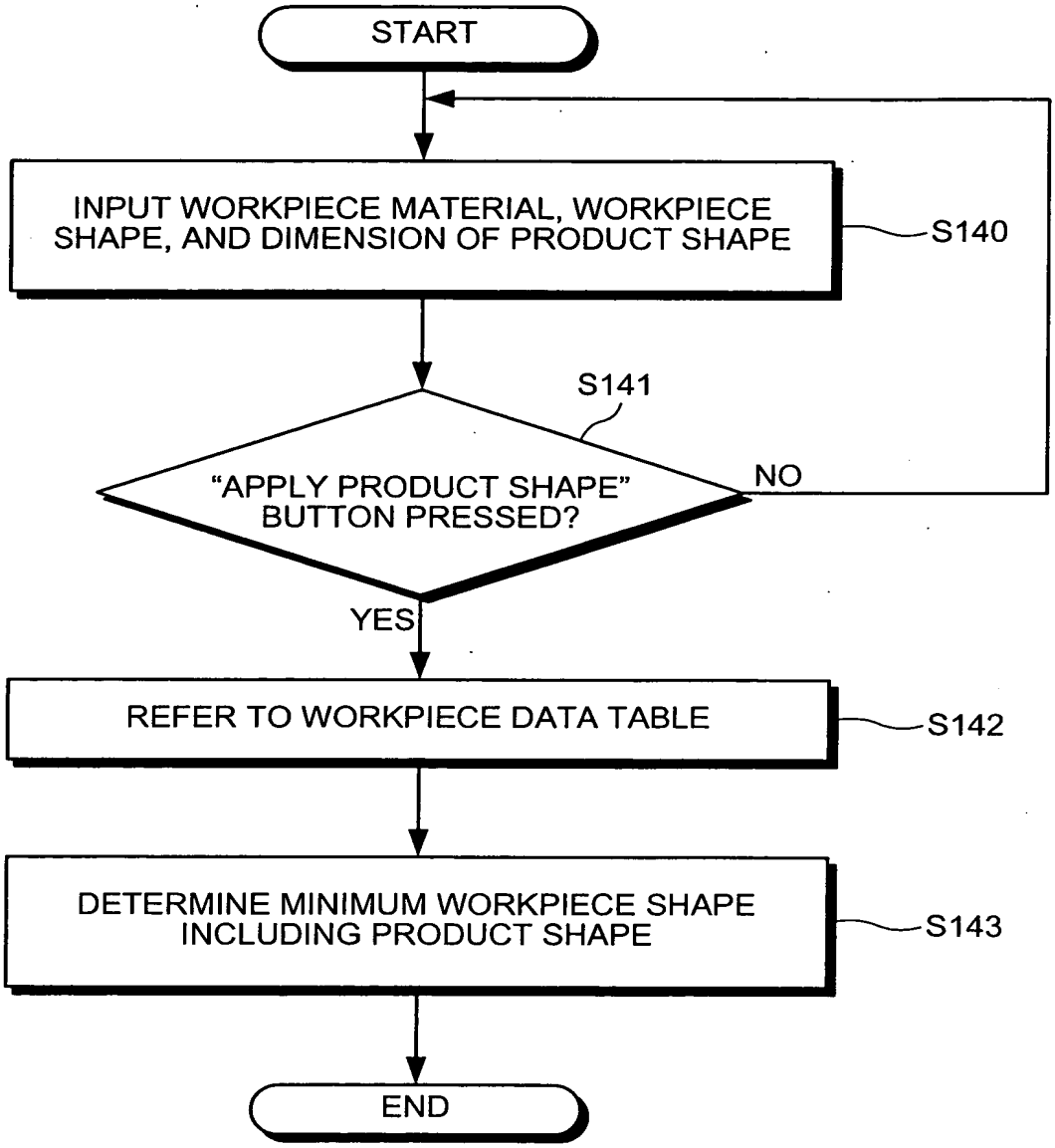

START
INPUT WORKPIECE MATERIAL, WORKPIECE SHAPE, AND DIMENSION OF PRODUCT SHAPE
S140
S141
"APPLY PRODUCT SHAPE" BUTTON PRESSED?
NO
YES
REFER TO WORKPIECE DATA TABLE
S142
DETERMINE MINIMUM WORKPIECE SHAPE INCLUDING PRODUCT SHAPE
S143
END

FIG.16

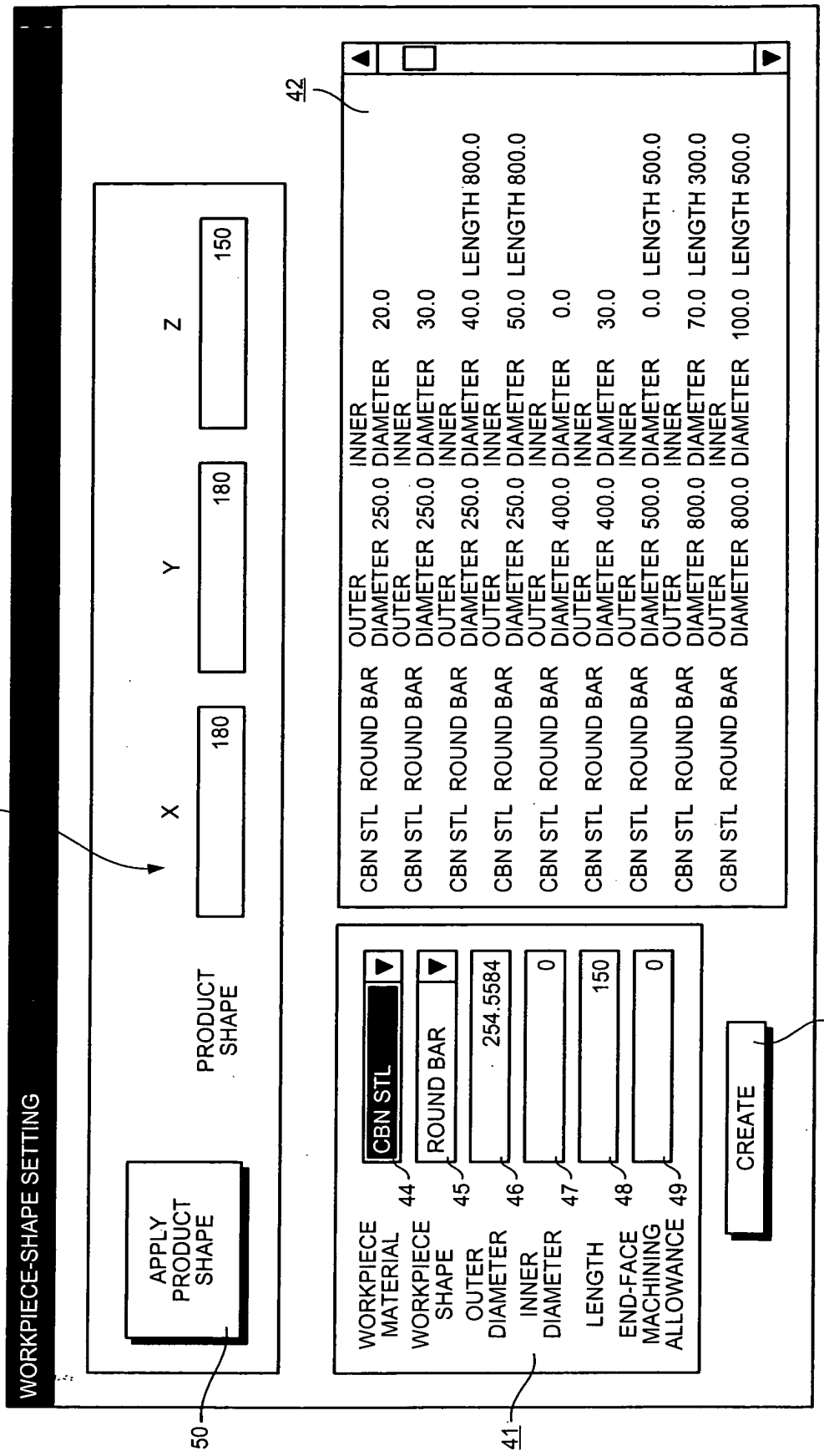

40
WORKPIECE-SHAPE SETTING
43
X
180
Y
180
Z
150
PRODUCT SHAPE
APPLY PRODUCT SHAPE
50
42
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 20.0
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 30.0
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 40.0 LENGTH 800.0
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 50.0 LENGTH 800.0
CBN STL ROUND BAR OUTER DIAMETER 400.0 INNER DIAMETER 0.0
CBN STL ROUND BAR OUTER DIAMETER 400.0 INNER DIAMETER 30.0
CBN STL ROUND BAR OUTER DIAMETER 500.0 INNER DIAMETER 0.0 LENGTH 500.0
CBN STL ROUND BAR OUTER DIAMETER 800.0 INNER DIAMETER 70.0 LENGTH 300.0
CBN STL ROUND BAR OUTER DIAMETER 800.0 INNER DIAMETER 100.0 LENGTH 500.0
WORKPIECE MATERIAL
CBN STL
44
WORKPIECE SHAPE
ROUND BAR
45
OUTER DIAMETER
254.5584
46
INNER DIAMETER
0
47
LENGTH
150
48
END-FACE MACHINING ALLOWANCE
0
49
41
CREATE
58

FIG.17

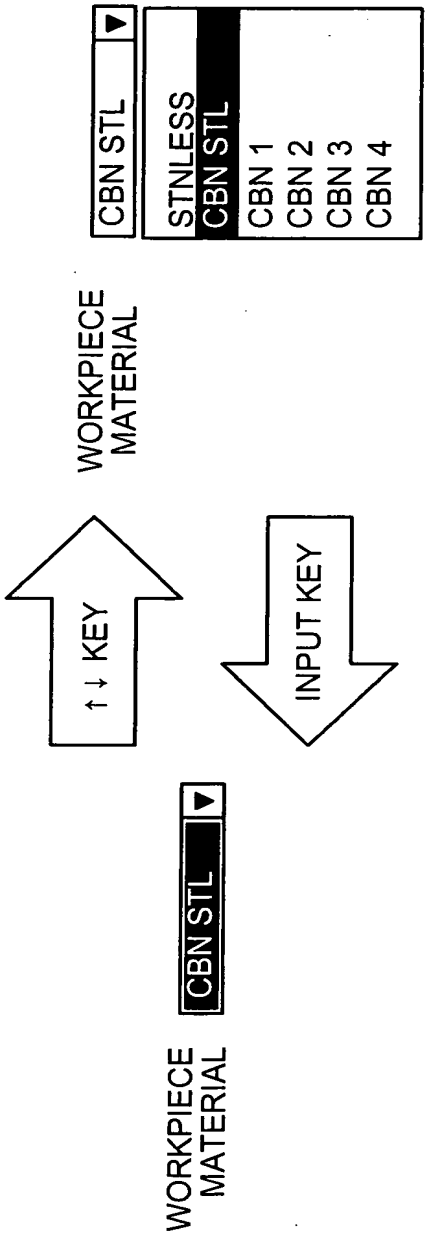

CBN STL
STNLESS
CBN STL
CBN 1
CBN 2
CBN 3
CBN 4
WORKPIECE MATERIAL
↑↓ KEY
INPUT KEY
CBN STL
WORKPIECE MATERIAL

FIG.18

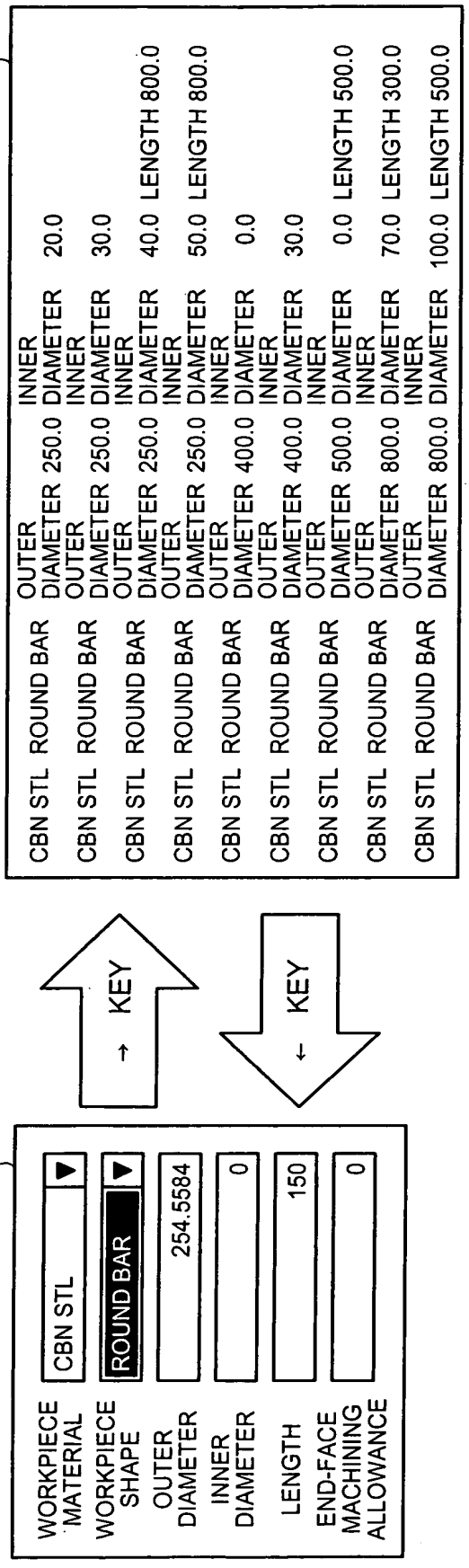

41
WORKPIECE MATERIAL
CBN STL
WORKPIECE SHAPE
ROUND BAR
OUTER DIAMETER
254.5584
INNER DIAMETER
0
LENGTH
150
END-FACE MACHINING ALLOWANCE
0
↑ KEY
↓ KEY
42
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 20.0
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 30.0
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 40.0 LENGTH 800.0
CBN STL ROUND BAR OUTER DIAMETER 250.0 INNER DIAMETER 50.0 LENGTH 800.0
CBN STL ROUND BAR OUTER DIAMETER 400.0 INNER DIAMETER 0.0
CBN STL ROUND BAR OUTER DIAMETER 400.0 INNER DIAMETER 30.0
CBN STL ROUND BAR OUTER DIAMETER 500.0 INNER DIAMETER 0.0 LENGTH 500.0
CBN STL ROUND BAR OUTER DIAMETER 800.0 INNER DIAMETER 70.0 LENGTH 300.0
CBN STL ROUND BAR OUTER DIAMETER 800.0 INNER DIAMETER 100.0 LENGTH 500.0

FIG.19

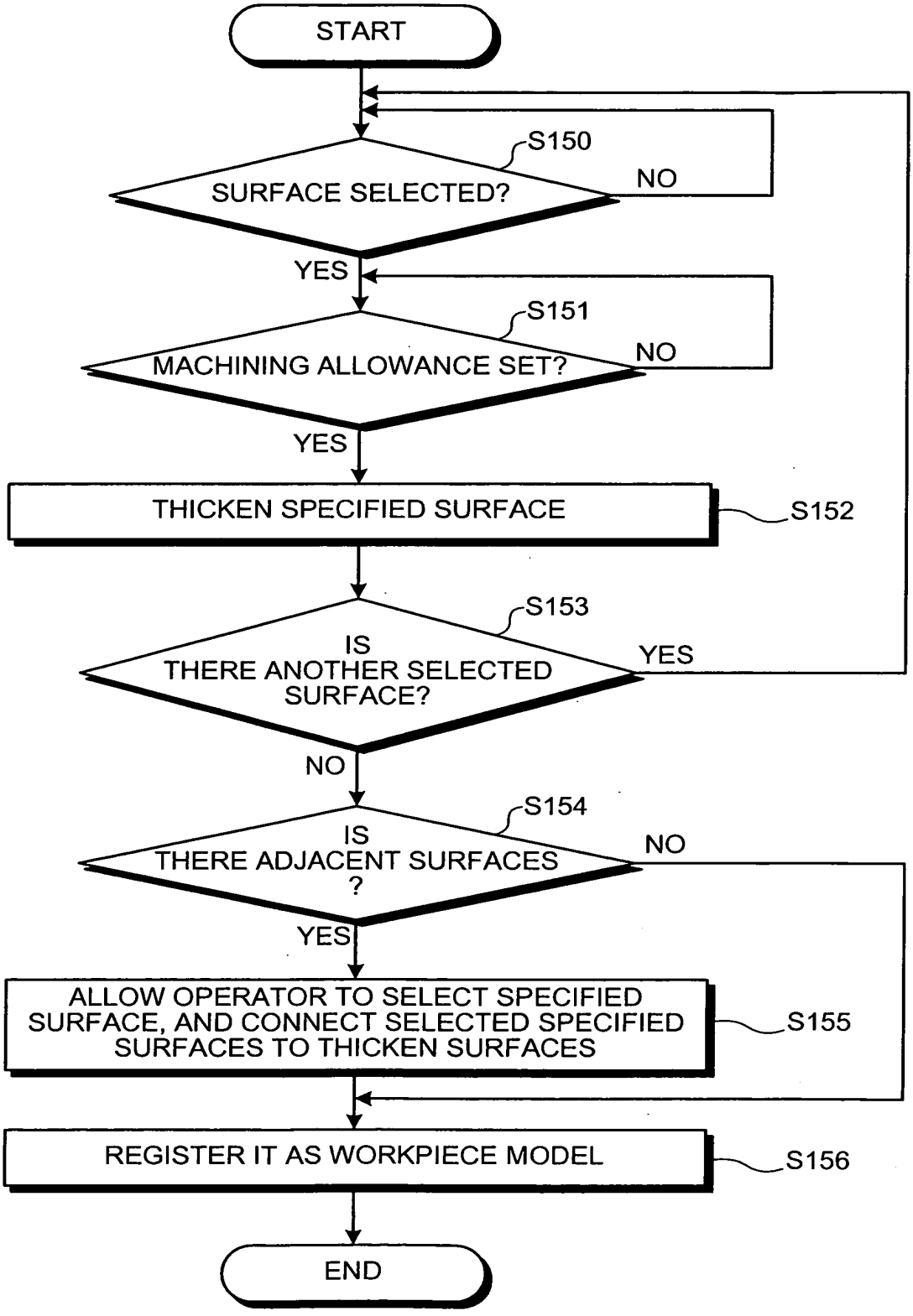

START
S150
SURFACE SELECTED?
NO
YES
S151
MACHINING ALLOWANCE SET?
NO
YES
THICKEN SPECIFIED SURFACE
S152
S153
IS THERE ANOTHER SELECTED SURFACE?
YES
NO
S154
IS THERE ADJACENT SURFACES ?
NO
YES
ALLOW OPERATOR TO SELECT SPECIFIED SURFACE, AND CONNECT SELECTED SPECIFIED SURFACES TO THICKEN SURFACES
S155
REGISTER IT AS WORKPIECE MODEL
S156
END

FIG.20

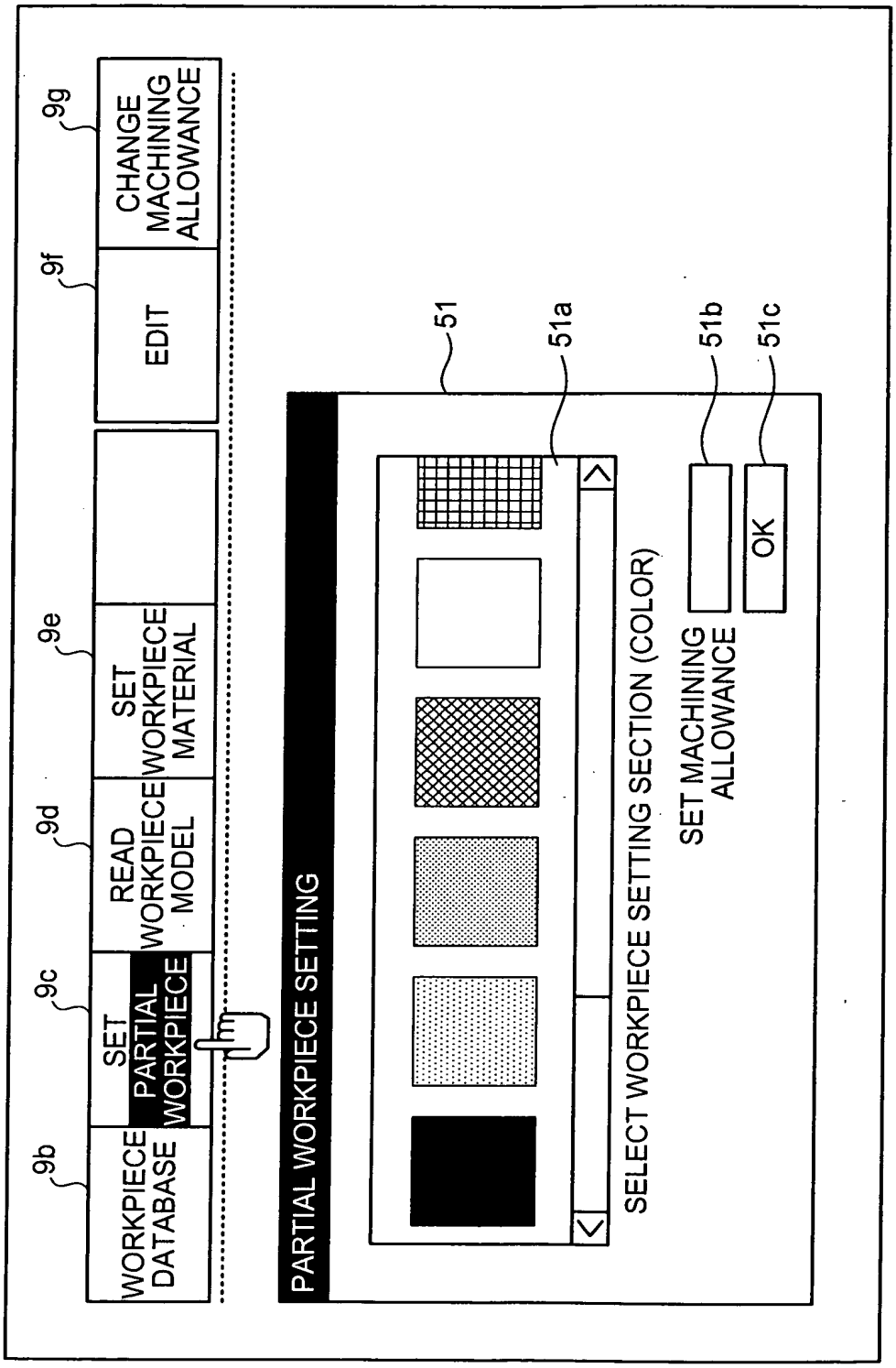

9b
WORKPIECE DATABASE
9c
SET PARTIAL WORKPIECE
9d
READ WORKPIECE MODEL
9e
SET WORKPIECE MATERIAL
9f
EDIT
9g
CHANGE MACHINING ALLOWANCE
PARTIAL WORKPIECE SETTING
51
51a
51b
51c
SELECT WORKPIECE SETTING SECTION (COLOR)
SET MACHINING ALLOWANCE
OK

FIG.21

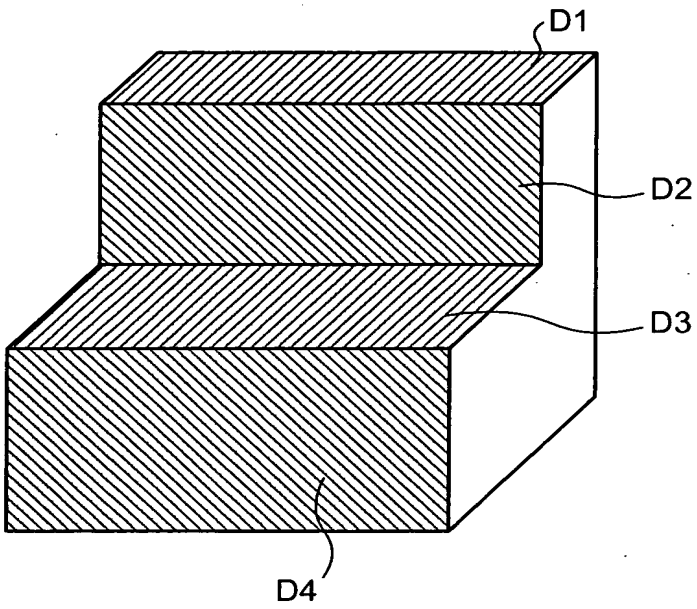



FIG.22

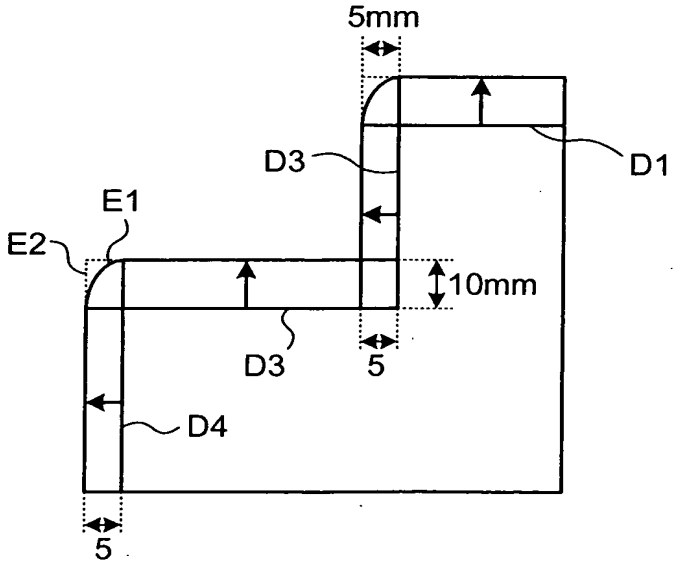


FIG.23

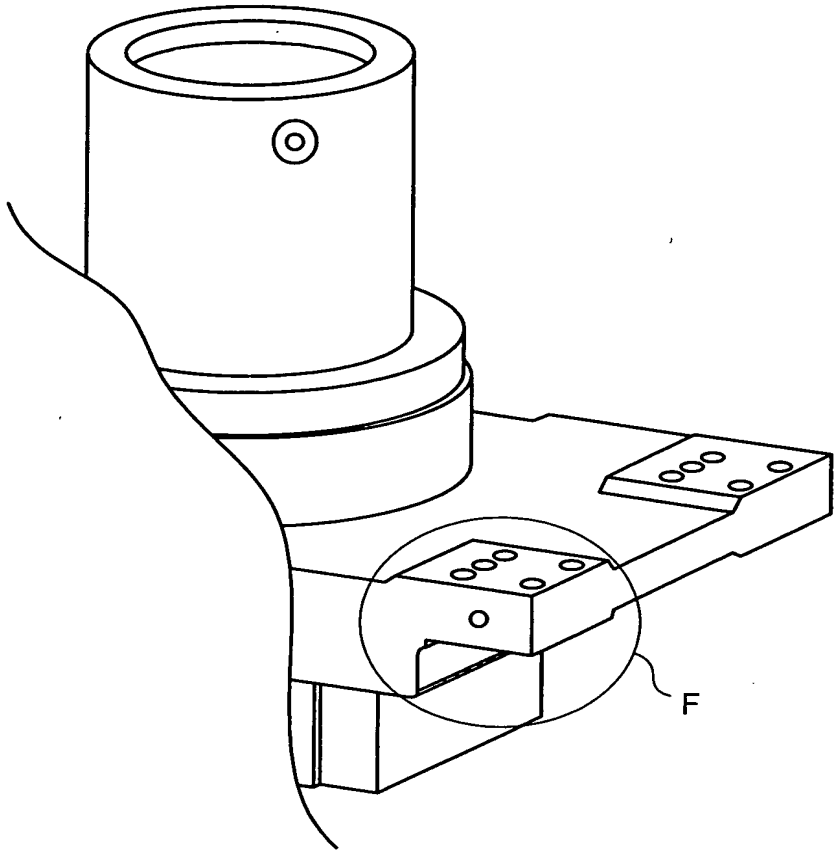



FIG.24

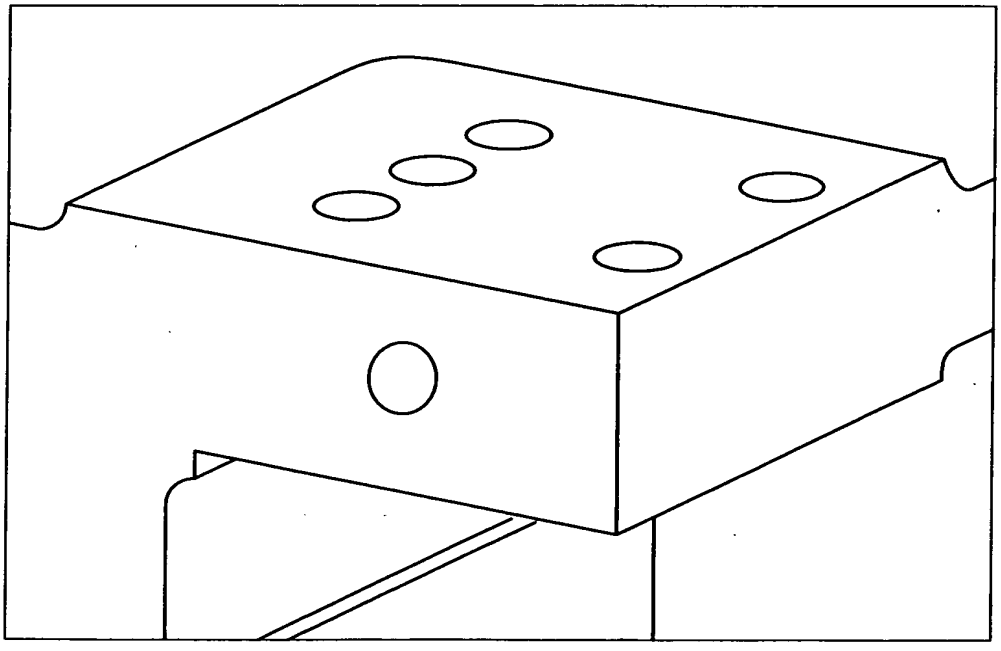


FIG.25

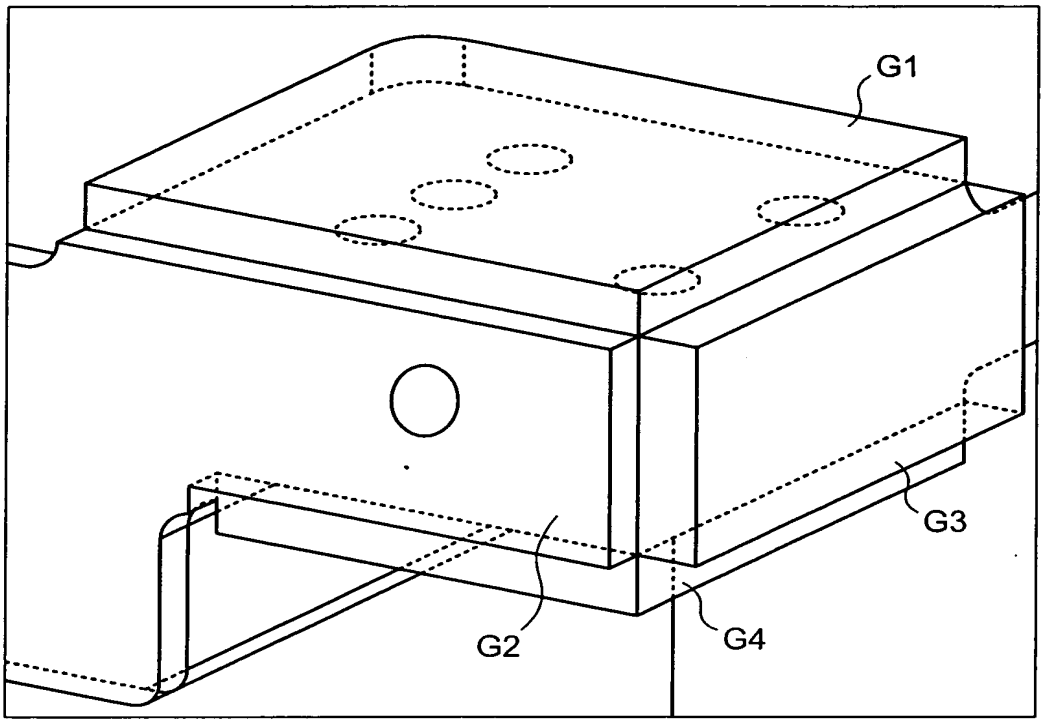


FIG.26

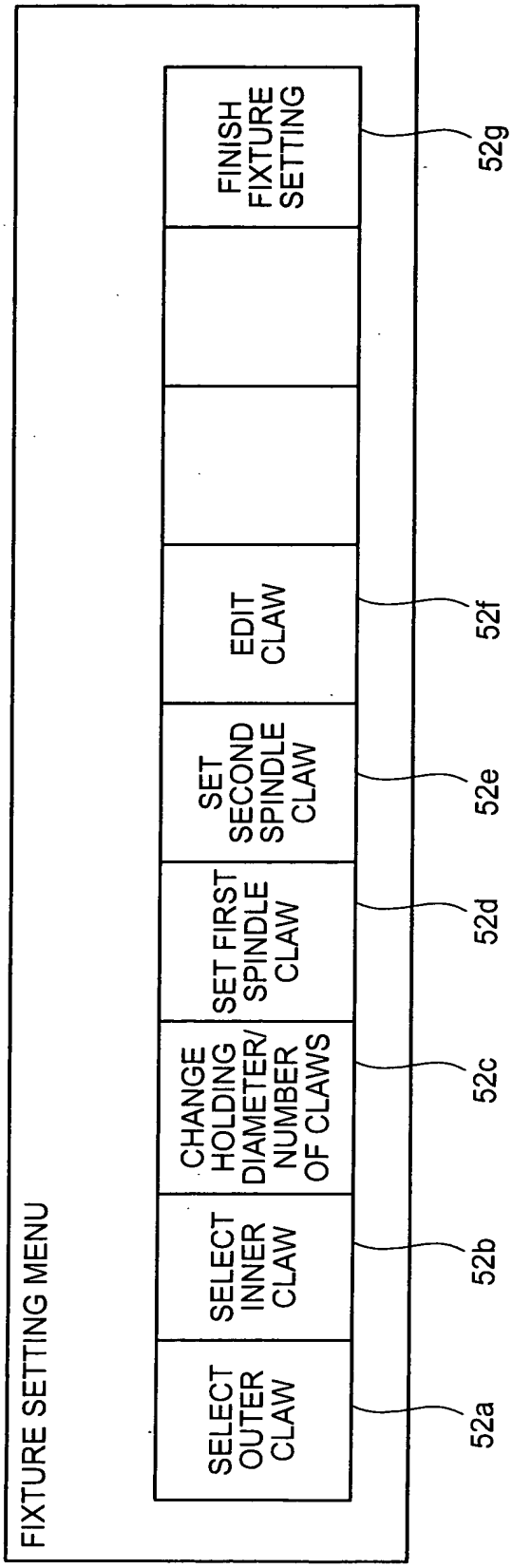

52
FIXTURE SETTING MENU
SELECT OUTER CLAW
SELECT INNER CLAW
CHANGE HOLDING DIAMETER/ NUMBER OF CLAWS
SET FIRST SPINDLE CLAW
SET SECOND SPINDLE CLAW
EDIT CLAW
FINISH FIXTURE SETTING
52a
52b
52c
52d
52e
52f
52g

FIG.27

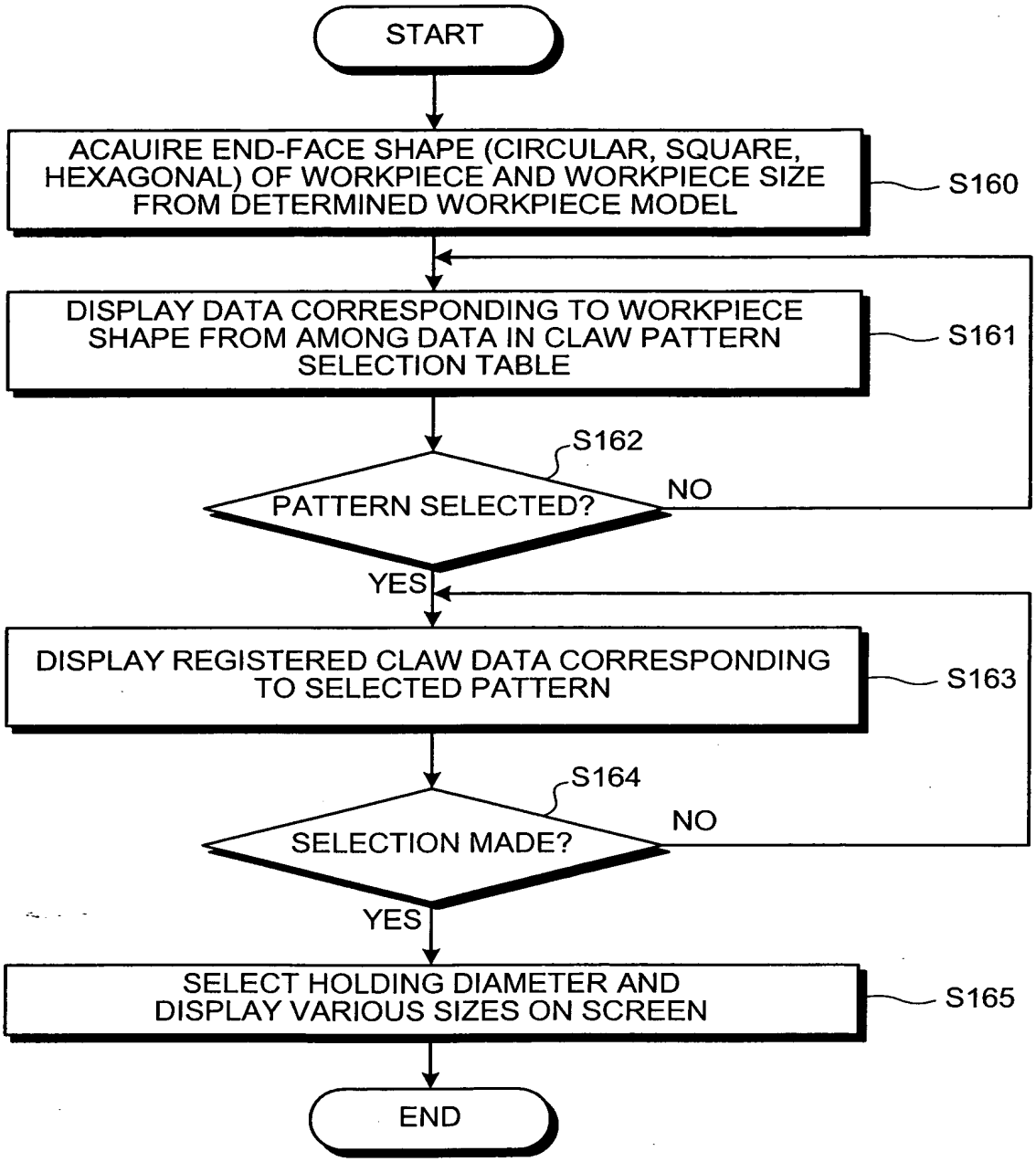

START
ACAUIRE END-FACE SHAPE (CIRCULAR, SQUARE, HEXAGONAL) OF WORKPIECE AND WORKPIECE SIZE FROM DETERMINED WORKPIECE MODEL
S160
DISPLAY DATA CORRESPONDING TO WORKPIECE SHAPE FROM AMONG DATA IN CLAW PATTERN SELECTION TABLE
S161
S162
PATTERN SELECTED?
NO
YES
DISPLAY REGISTERED CLAW DATA CORRESPONDING TO SELECTED PATTERN
S163
S164
SELECTION MADE?
NO
YES
SELECT HOLDING DIAMETER AND DISPLAY VARIOUS SIZES ON SCREEN
S165
END

FIG.28

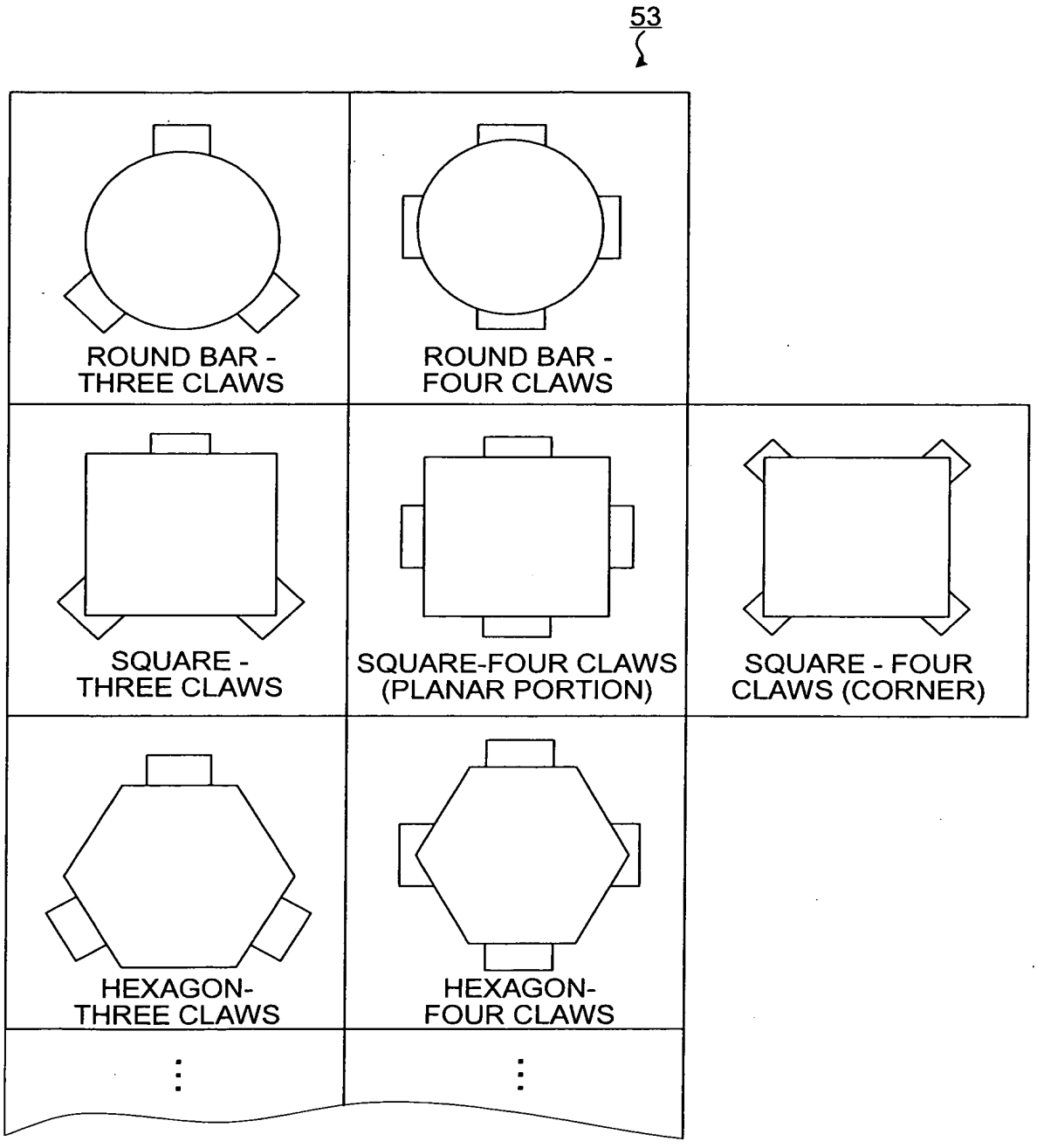

53
ROUND BAR - THREE CLAWS
ROUND BAR - FOUR CLAWS
SQUARE - THREE CLAWS
SQUARE-FOUR CLAWS (PLANAR PORTION)
SQUARE - FOUR CLAWS (CORNER)
HEXAGON- THREE CLAWS
HEXAGON- FOUR CLAWS

FIG.29

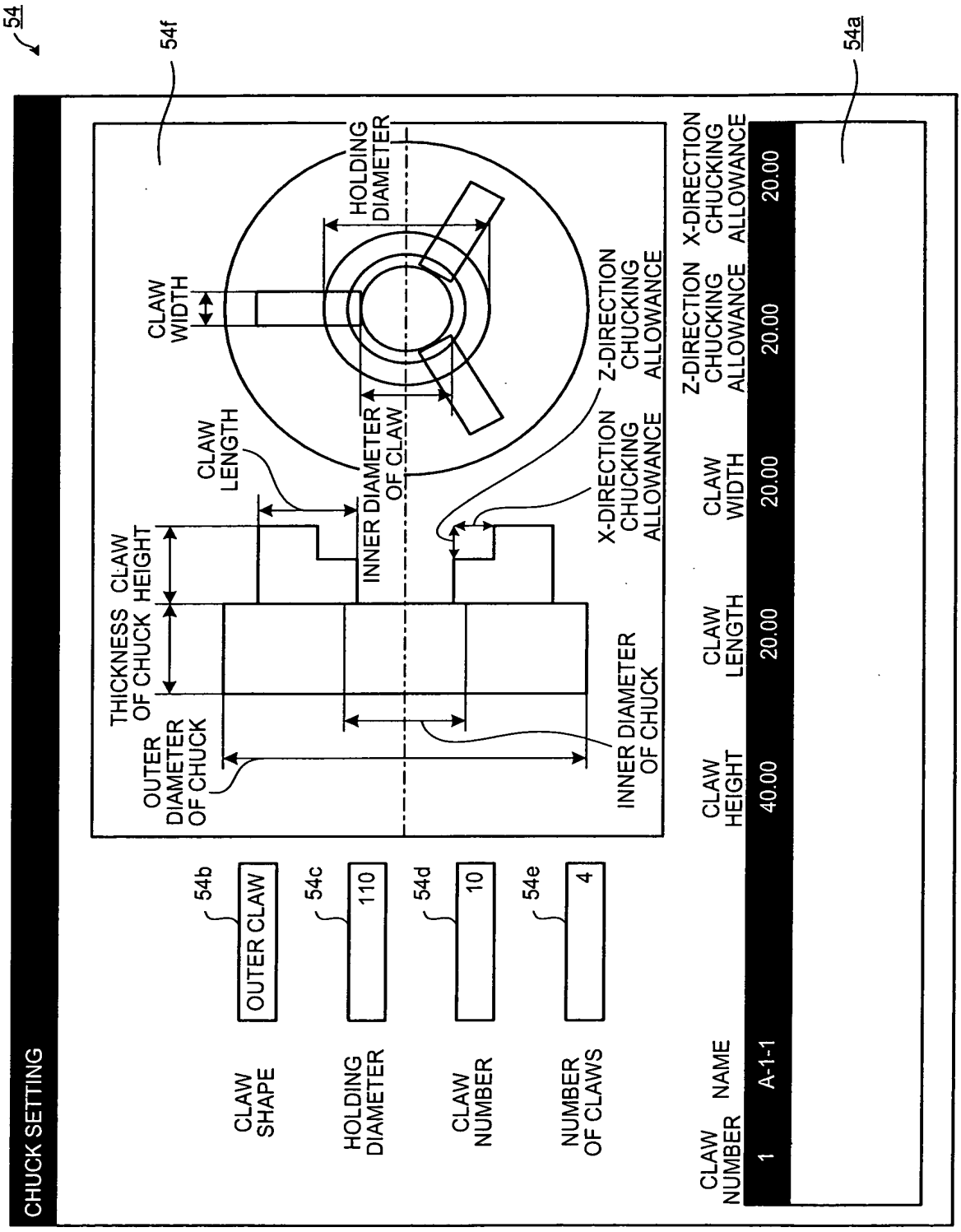

54
54f
54a
CHUCK SETTING
CLAW WIDTH
HOLDING DIAMETER
CLAW LENGTH
INNER DIAMETER OF CLAW
Z-DIRECTION CHUCKING ALLOWANCE
X-DIRECTION CHUCKING ALLOWANCE
THICKNESS OF CHUCK
CLAW HEIGHT
OUTER DIAMETER OF CHUCK
INNER DIAMETER OF CHUCK
54b
OUTER CLAW
CLAW SHAPE
54c
110
HOLDING DIAMETER
54d
10
CLAW NUMBER
54e
4
NUMBER OF CLAWS
CLAW NUMBER
NAME
CLAW HEIGHT
CLAW LENGTH
CLAW WIDTH
Z-DIRECTION CHUCKING ALLOWANCE
X-DIRECTION CHUCKING ALLOWANCE
1
A-1-1
40.00
20.00
20.00
20.00
20.00

FIG.30

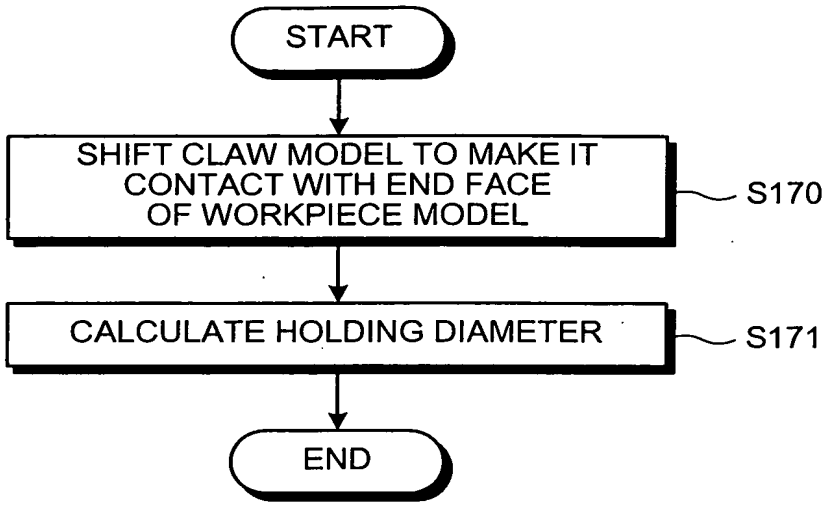

START
SHIFT CLAW MODEL TO MAKE IT CONTACT WITH END FACE OF WORKPIECE MODEL
S170
CALCULATE HOLDING DIAMETER
S171
END

FIG.31

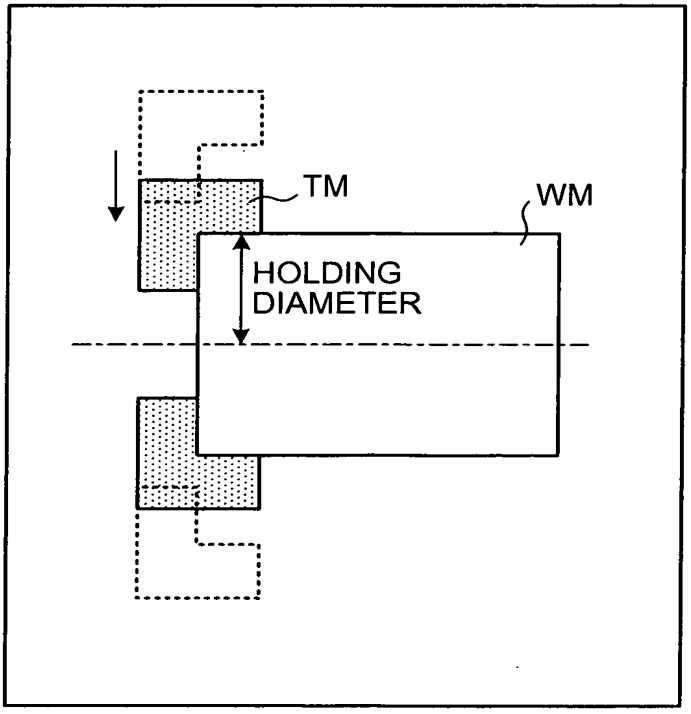

TM
WM
HOLDING DIAMETER

FIG.32

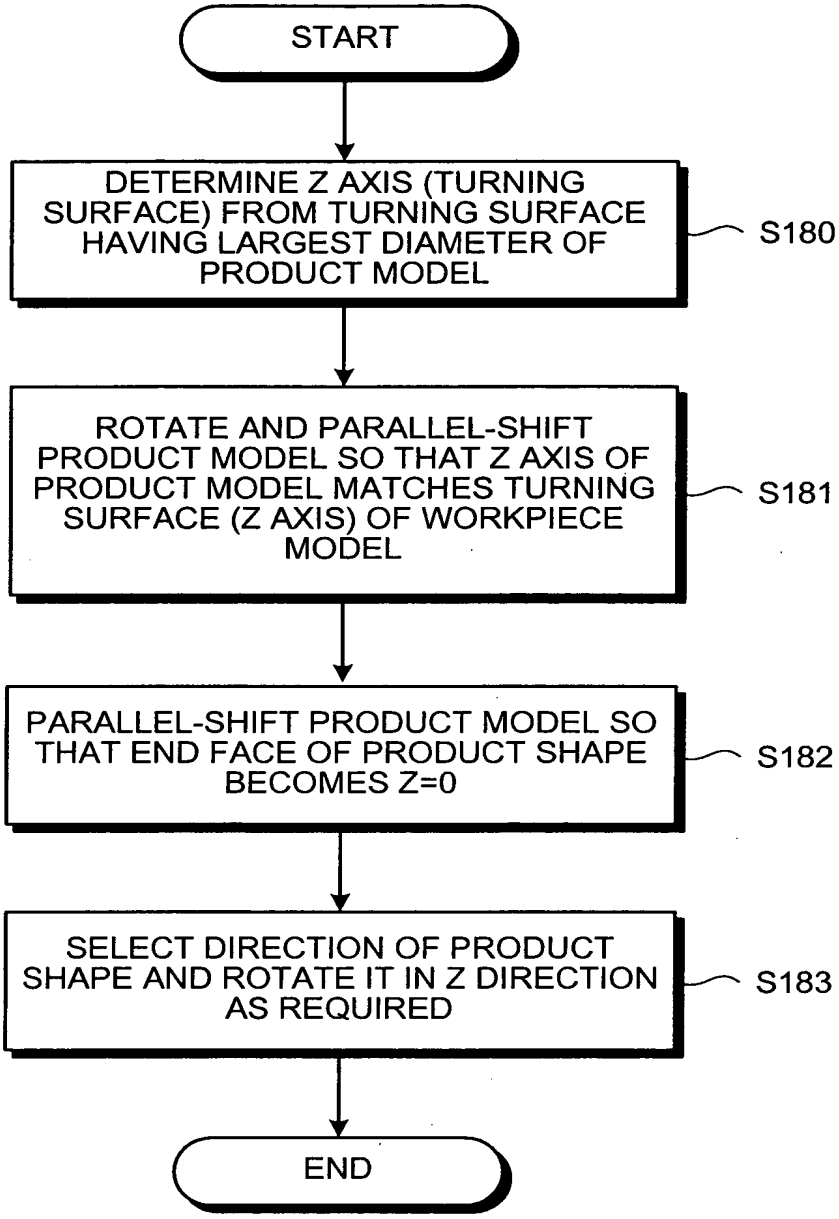

START
DETERMINE Z AXIS (TURNING SURFACE) FROM TURNING SURFACE HAVING LARGEST DIAMETER OF PRODUCT MODEL
S180
ROTATE AND PARALLEL-SHIFT PRODUCT MODEL SO THAT Z AXIS OF PRODUCT MODEL MATCHES TURNING SURFACE (Z AXIS) OF WORKPIECE MODEL
S181
PARALLEL-SHIFT PRODUCT MODEL SO THAT END FACE OF PRODUCT SHAPE BECOMES Z=0
S182
SELECT DIRECTION OF PRODUCT SHAPE AND ROTATE IT IN Z DIRECTION AS REQUIRED
S183
END

FIG.33

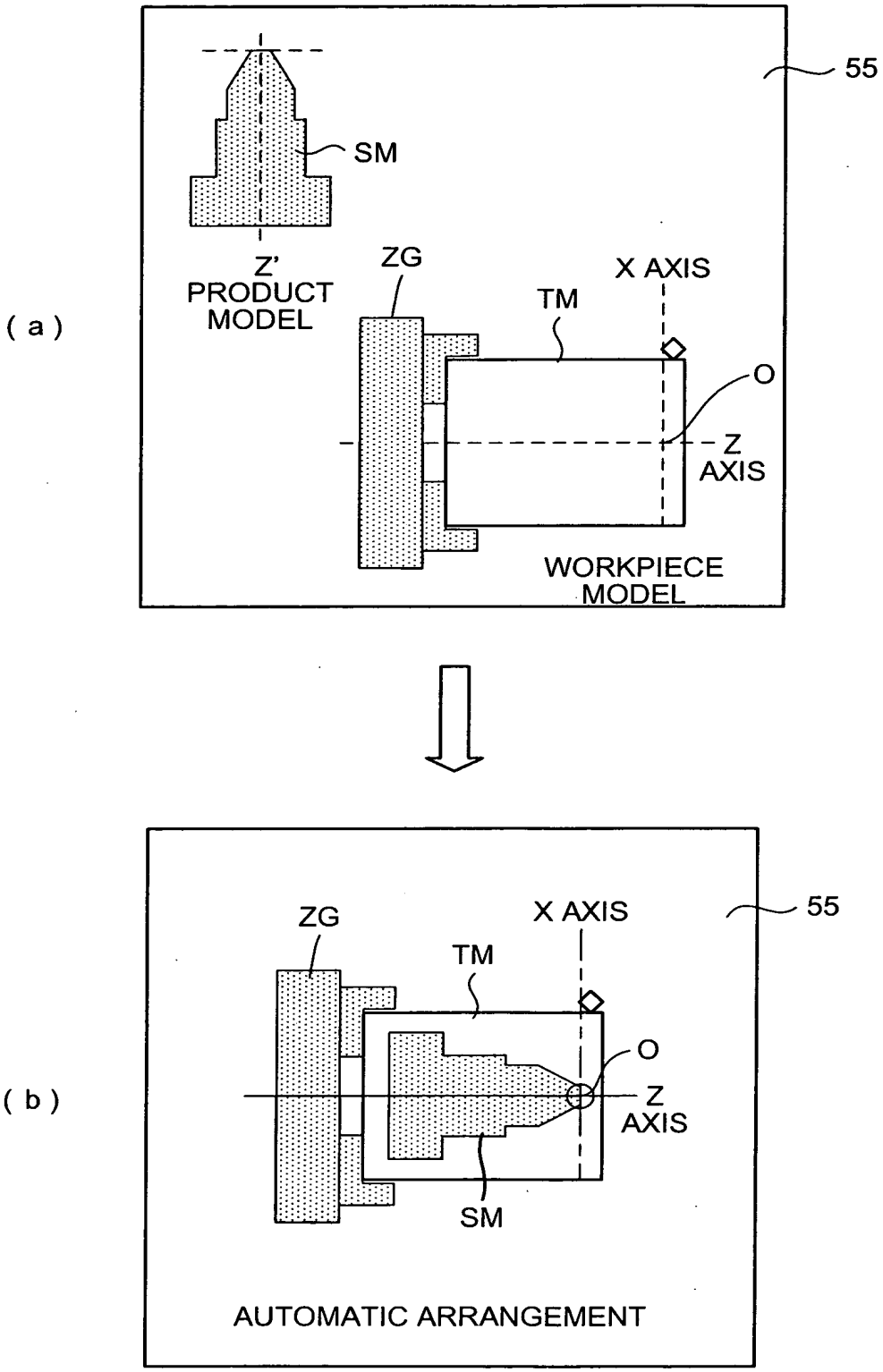

( a )
55
SM
Z'
PRODUCT
MODEL
ZG
TM
X AXIS
O
Z
AXIS
WORKPIECE
MODEL
( b )
55
ZG
X AXIS
TM
O
Z
AXIS
SM
AUTOMATIC ARRANGEMENT

FIG.34A

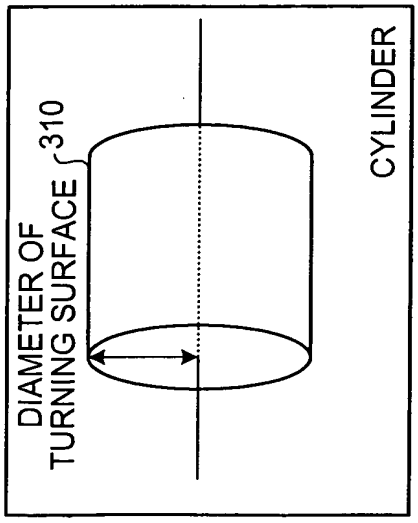



FIG.34B

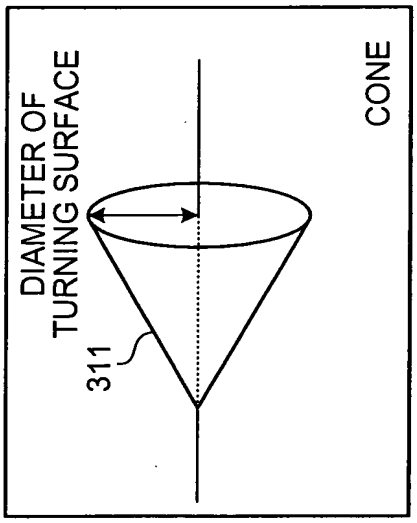



FIG.34E

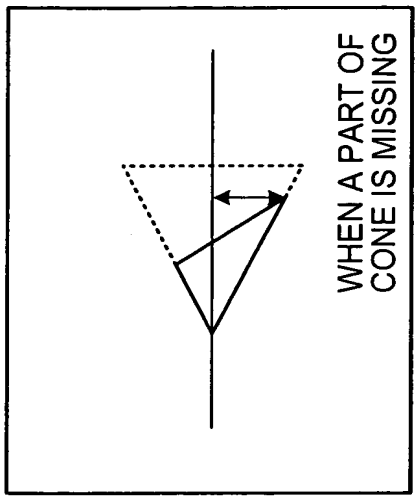



FIG.34C

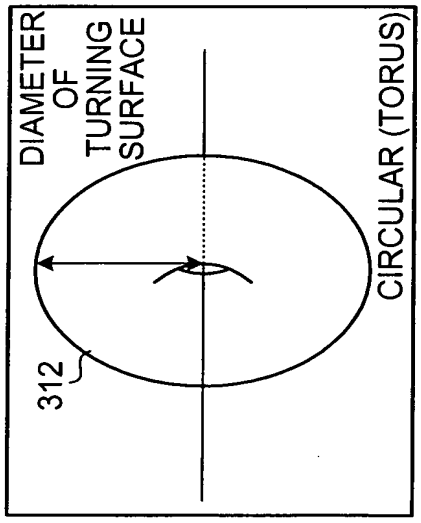



FIG.34D

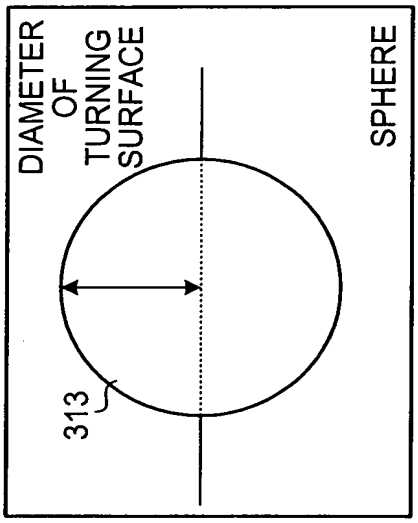


FIG.35

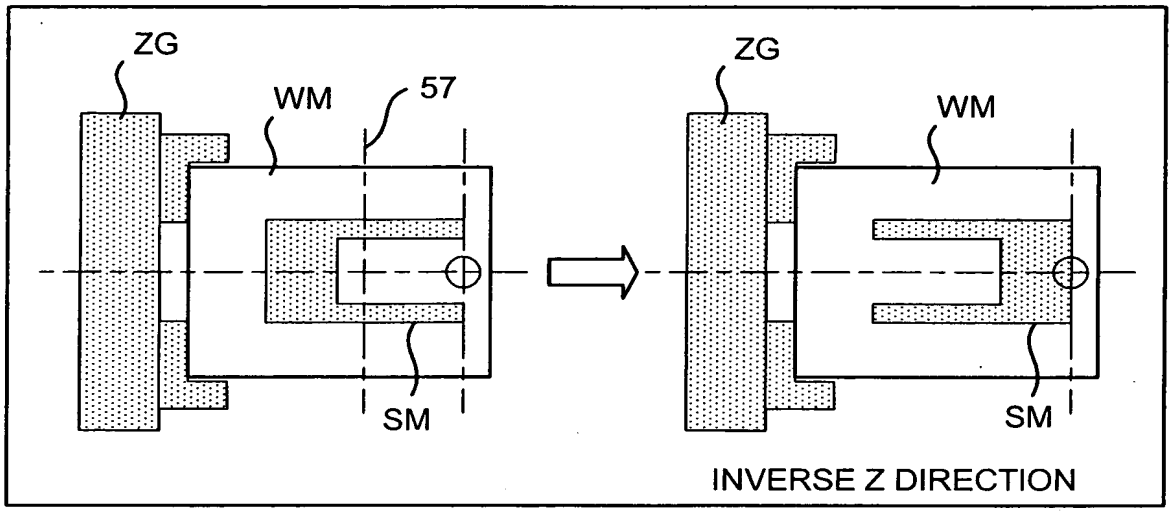


FIG.36

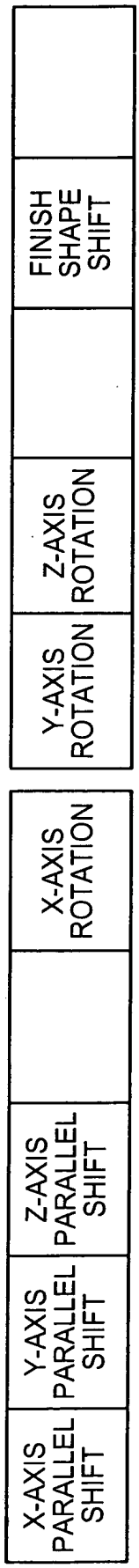

X-AXIS PARALLEL SHIFT
Y-AXIS PARALLEL SHIFT
Z-AXIS PARALLEL SHIFT
X-AXIS ROTATION
Y-AXIS ROTATION
Z-AXIS ROTATION
FINISH SHAPE SHIFT

FIG.37

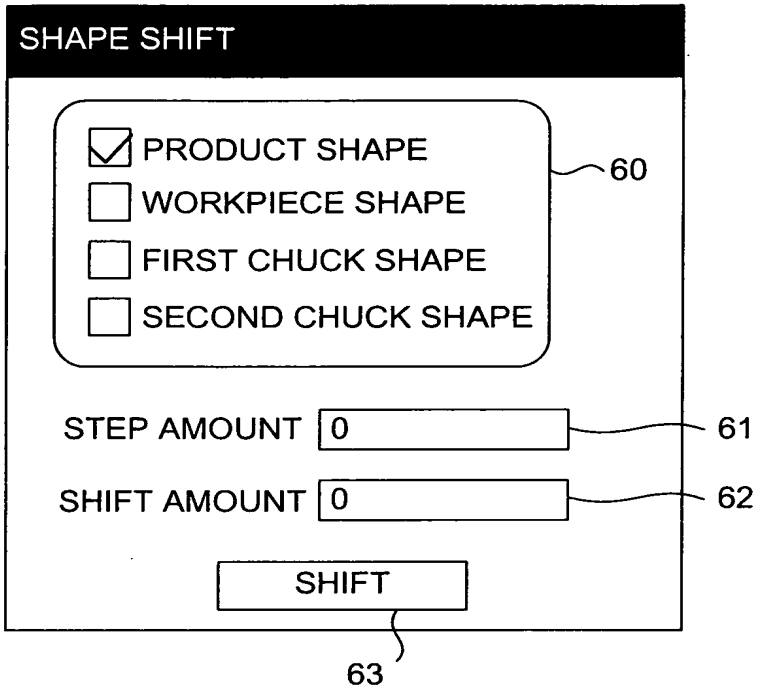

SHAPE SHIFT
PRODUCT SHAPE
WORKPIECE SHAPE
FIRST CHUCK SHAPE
SECOND CHUCK SHAPE
60
STEP AMOUNT
0
61
SHIFT AMOUNT
0
62
SHIFT
63

FIG.38

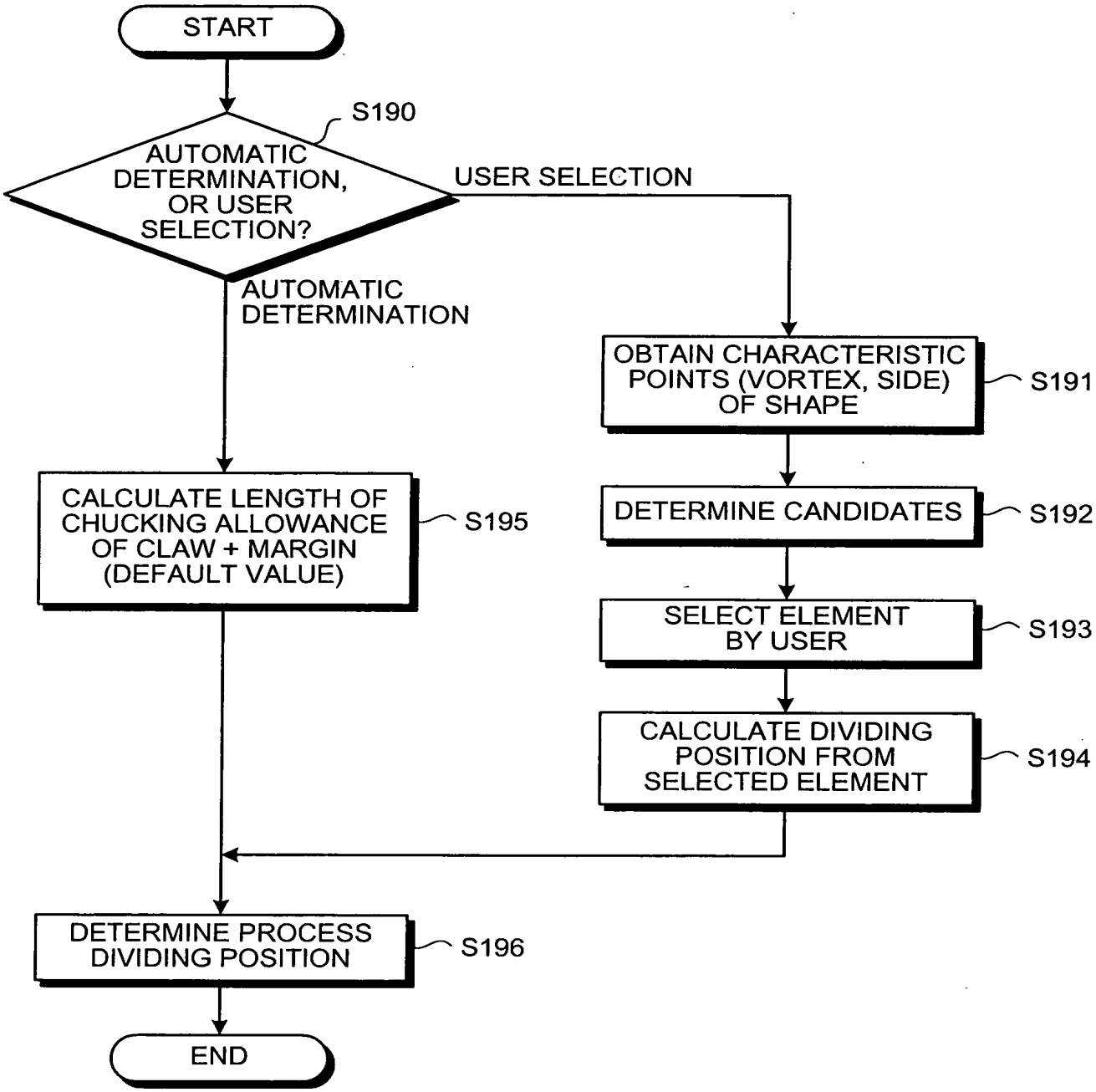

START
S190
AUTOMATIC DETERMINATION, OR USER SELECTION?
USER SELECTION
AUTOMATIC DETERMINATION
OBTAIN CHARACTERISTIC POINTS (VORTEX, SIDE) OF SHAPE
S191
DETERMINE CANDIDATES
S192
SELECT ELEMENT BY USER
S193
CALCULATE DIVIDING POSITION FROM SELECTED ELEMENT
S194
CALCULATE LENGTH OF CHUCKING ALLOWANCE OF CLAW + MARGIN (DEFAULT VALUE)
S195
DETERMINE PROCESS DIVIDING POSITION
S196
END

FIG.39

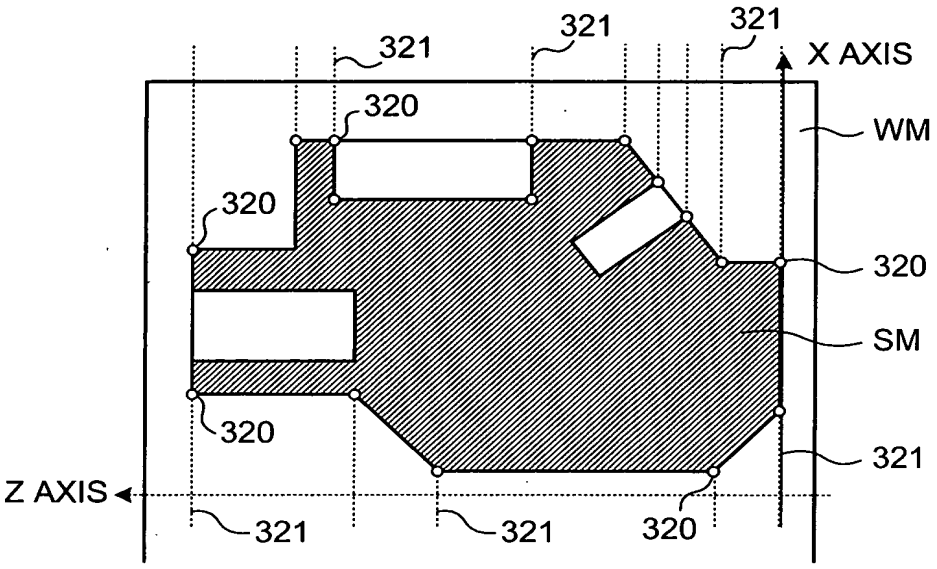

321
321
321
X AXIS
320
WM
320
320
SM
320
321
Z AXIS
321
321
320

FIG.40

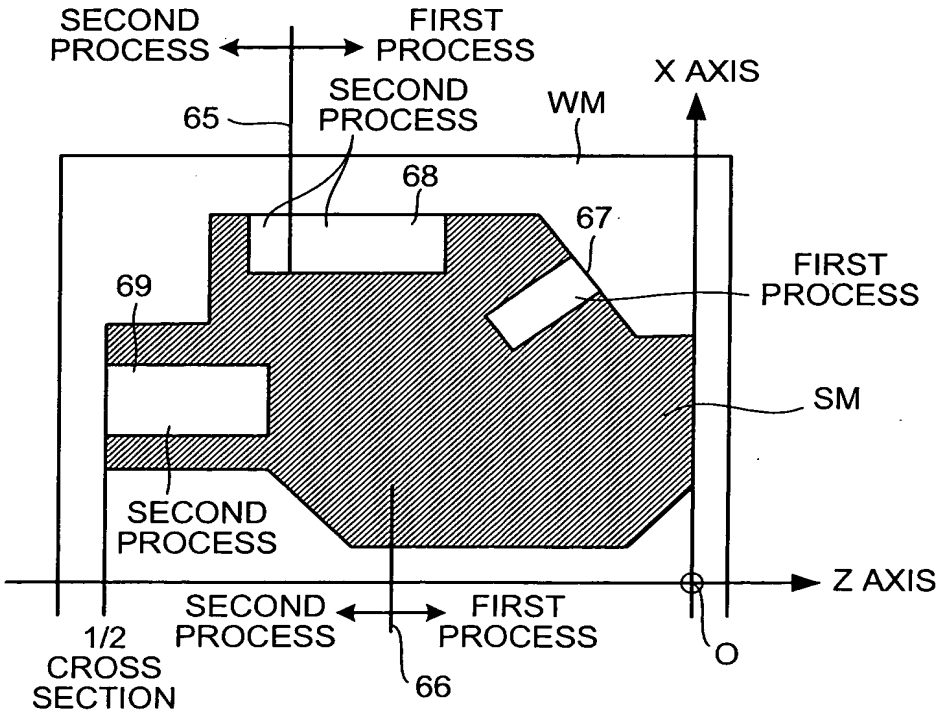

SECOND PROCESS
FIRST PROCESS
X AXIS
65
SECOND PROCESS
WM
68
67
69
FIRST PROCESS
SM
SECOND PROCESS
Z AXIS
SECOND PROCESS
FIRST PROCESS
1/2 CROSS SECTION
66
O

FIG.41

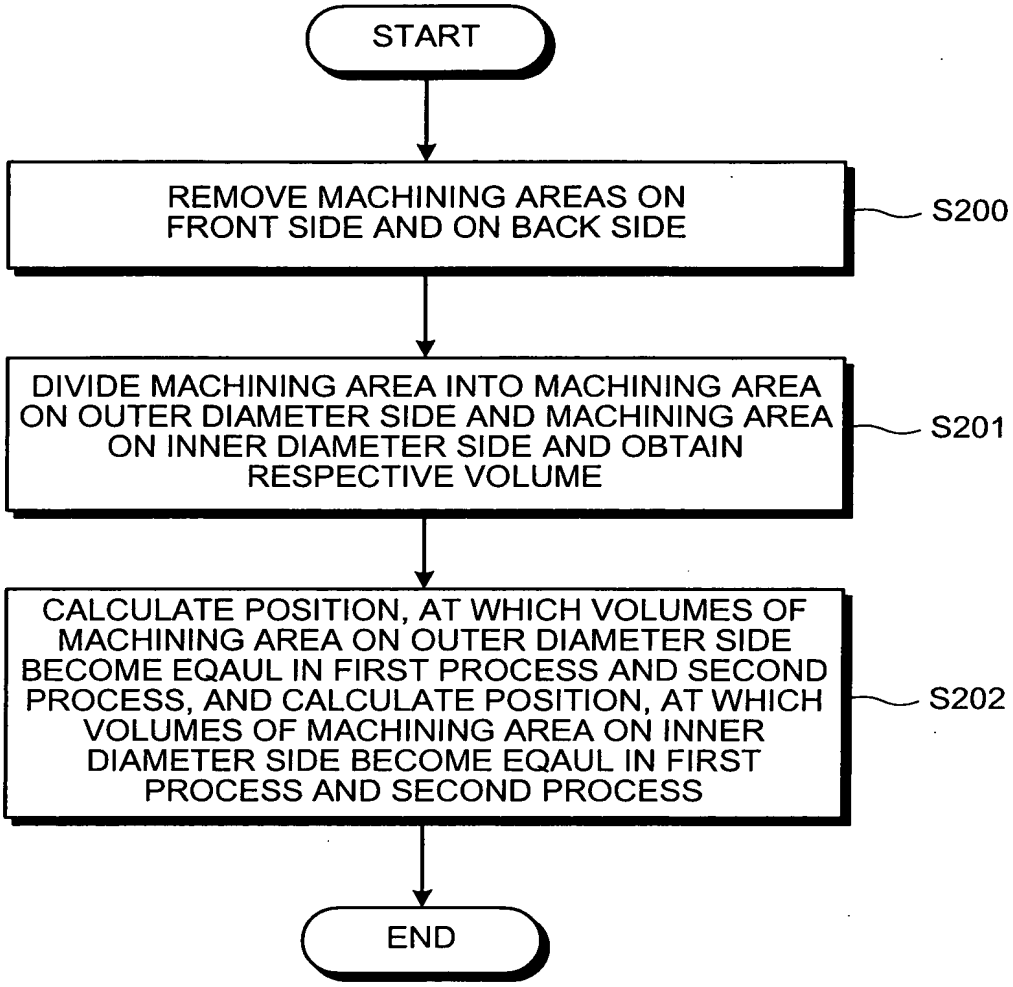

START
REMOVE MACHINING AREAS ON FRONT SIDE AND ON BACK SIDE
S200
DIVIDE MACHINING AREA INTO MACHINING AREA ON OUTER DIAMETER SIDE AND MACHINING AREA ON INNER DIAMETER SIDE AND OBTAIN RESPECTIVE VOLUME
S201
CALCULATE POSITION, AT WHICH VOLUMES OF MACHINING AREA ON OUTER DIAMETER SIDE BECOME EQAUL IN FIRST PROCESS AND SECOND PROCESS, AND CALCULATE POSITION, AT WHICH VOLUMES OF MACHINING AREA ON INNER DIAMETER SIDE BECOME EQAUL IN FIRST PROCESS AND SECOND PROCESS
S202
END

FIG.42A

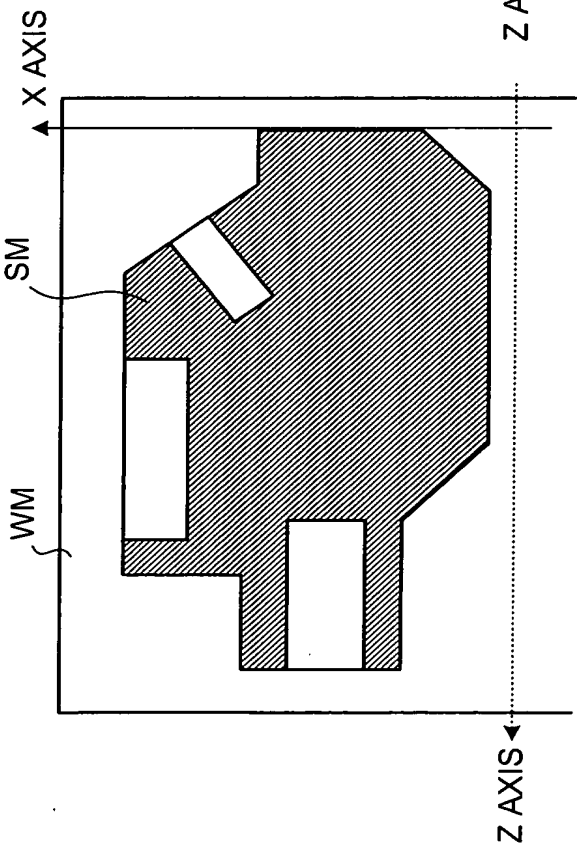



FIG.42B

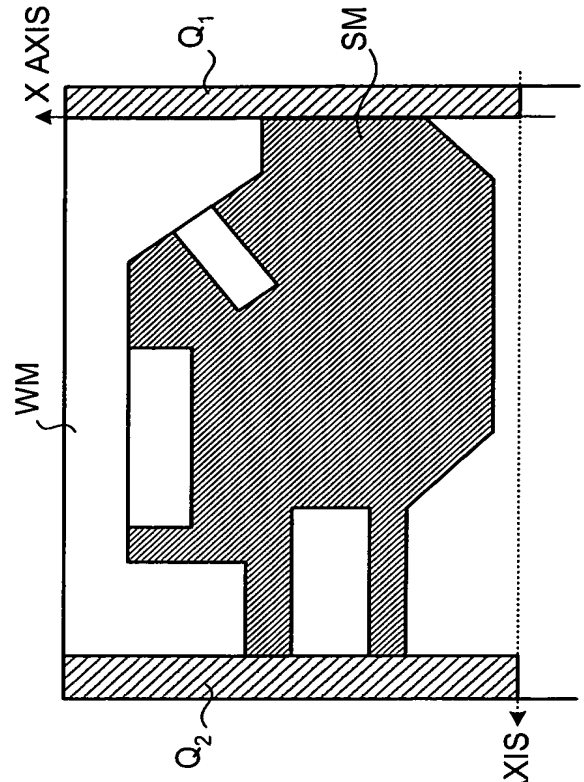



FIG.42C

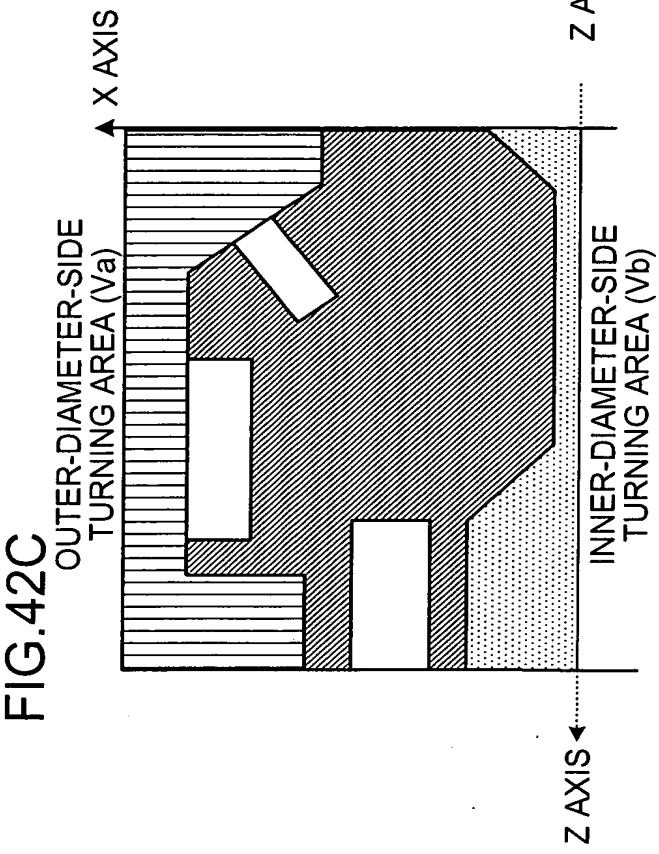



FIG.42D

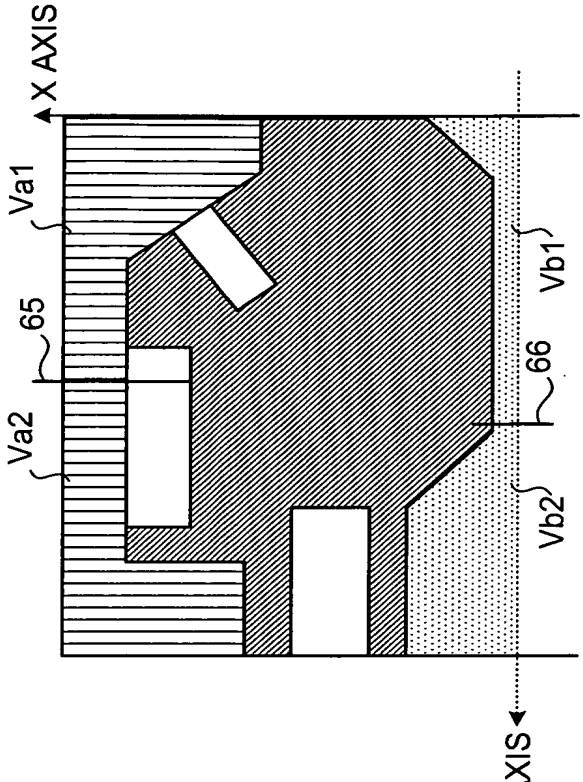


FIG.43

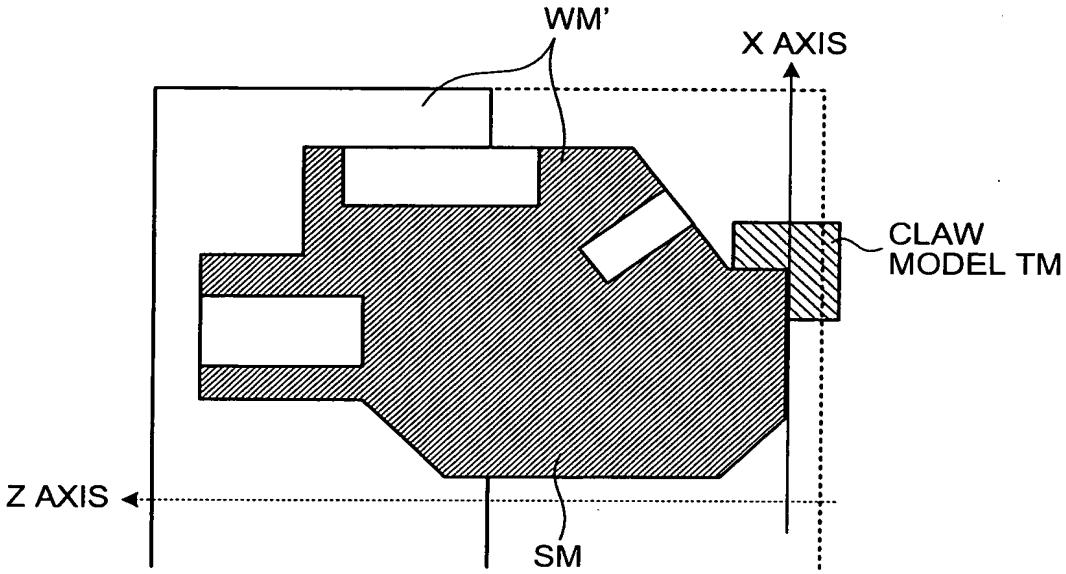
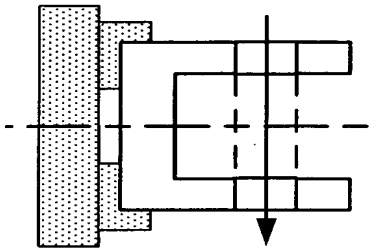
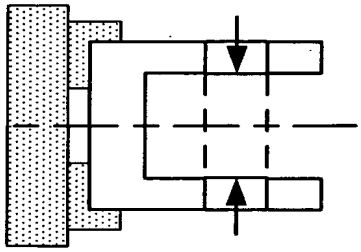


FIG.44A



THROUGH HOLE

FIG.44B



TWO HOLES

FIG.45

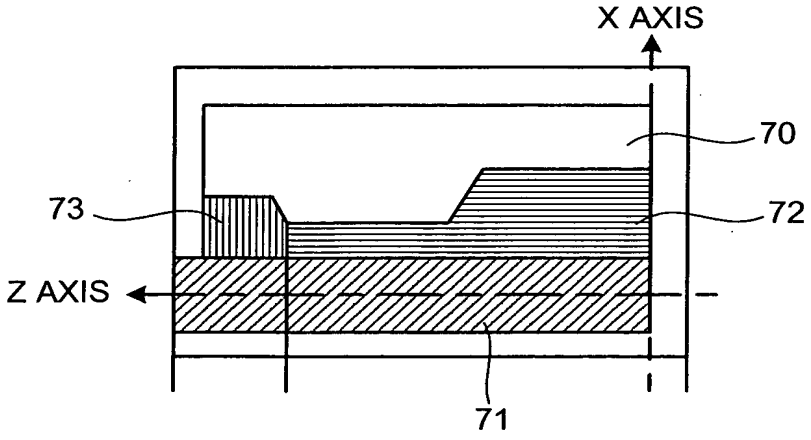


FIG.46

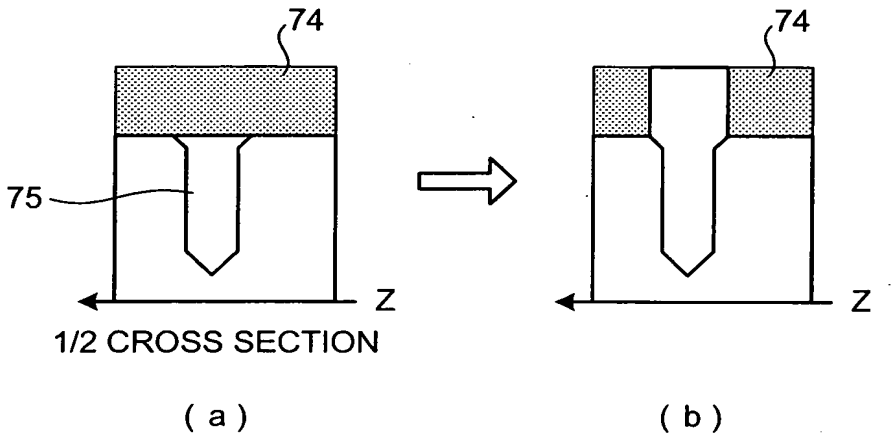

74
75
Z
1/2 CROSS SECTION
( a )
74
Z
( b )

FIG.47

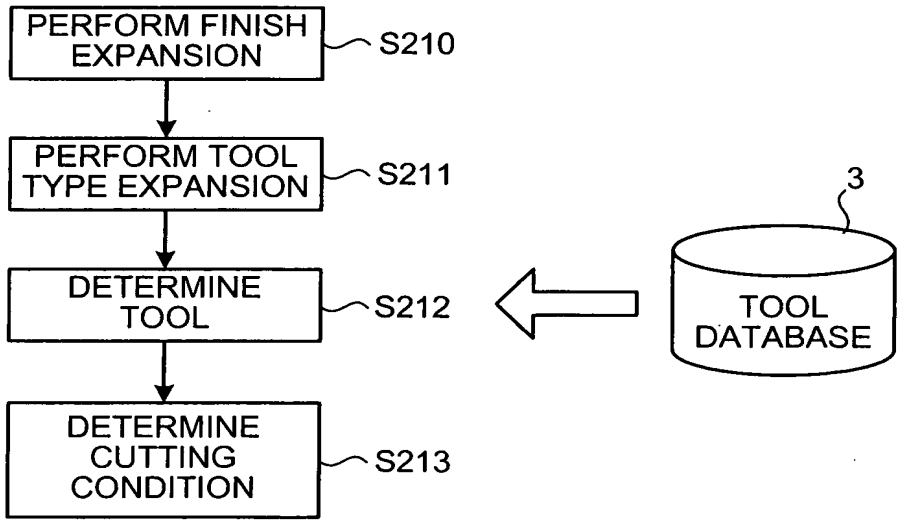
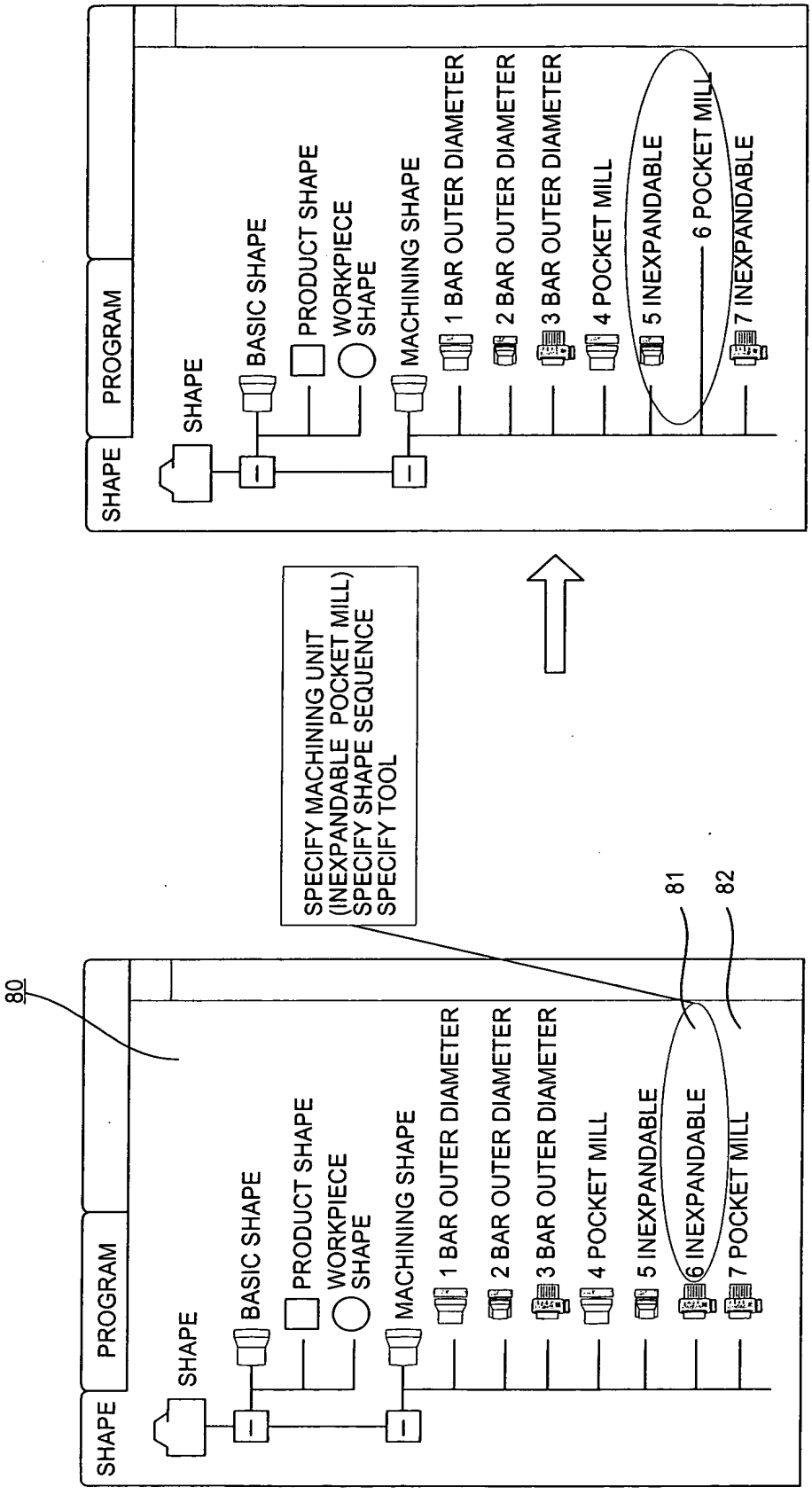

PERFORM FINISH EXPANSION
S210
PERFORM TOOL TYPE EXPANSION
S211
DETERMINE TOOL
S212
DETERMINE CUTTING CONDITION
S213
3
TOOL DATABASE

FIG.48


SHAPE
PROGRAM
SHAPE
BASIC SHAPE
PRODUCT SHAPE
WORKPIECE SHAPE
MACHINING SHAPE
1 BAR OUTER DIAMETER
2 BAR OUTER DIAMETER
3 BAR OUTER DIAMETER
4 POCKET MILL
5 INEXPANDABLE
6 INEXPANDABLE
7 POCKET MILL
80
81
82
SPECIFY MACHINING UNIT
(INEXPANDABLE POCKET MILL)
SPECIFY SHAPE SEQUENCE
SPECIFY TOOL
(a)
(b)

# FIG.49

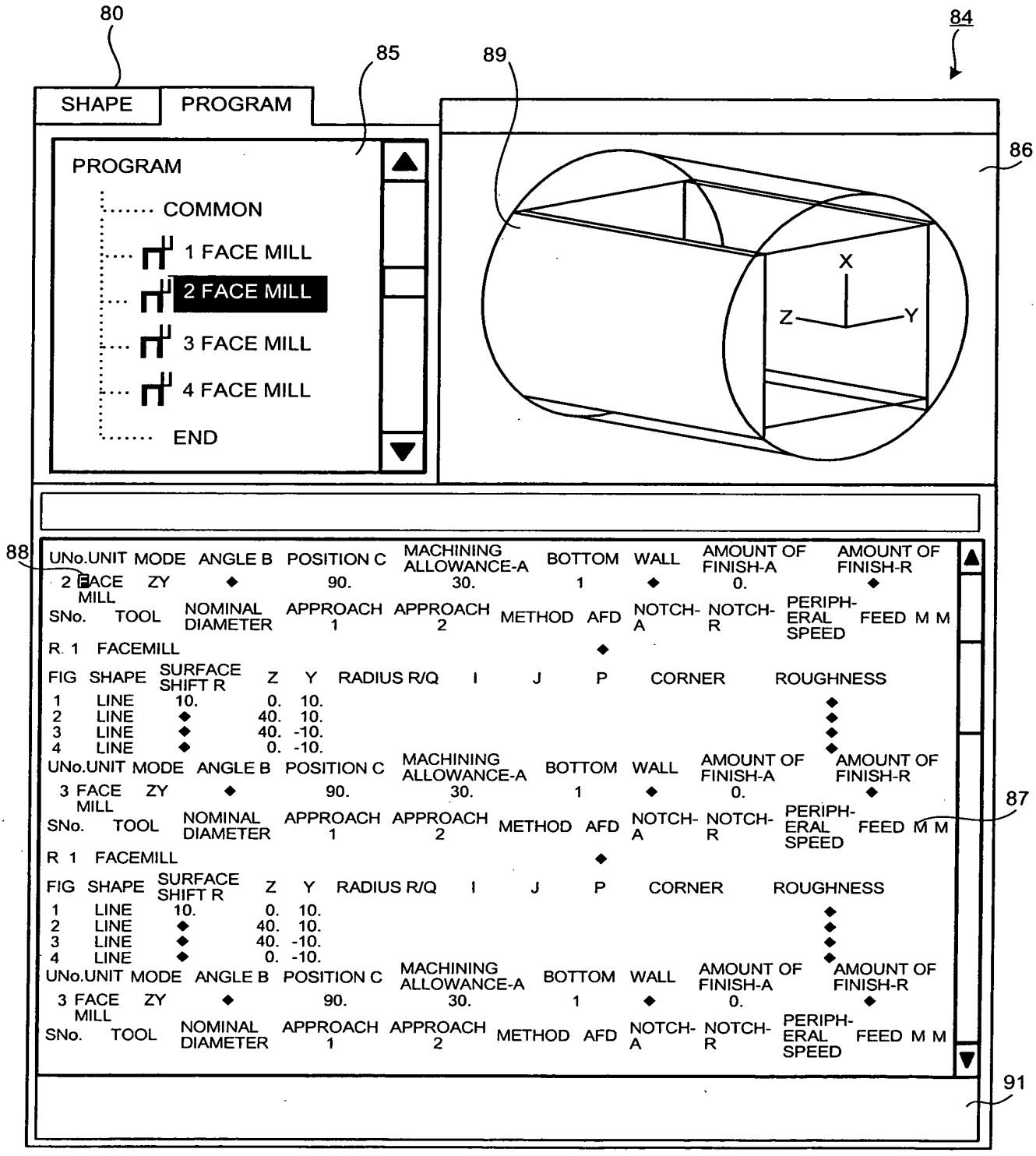

80
84
85
89
SHAPE
PROGRAM
PROGRAM
COMMON
1 FACE MILL
2 FACE MILL
3 FACE MILL
4 FACE MILL
END
86
X
Z
Y
88
UNo.UNIT MODE ANGLE B POSITION C MACHINING ALLOWANCE-A BOTTOM WALL AMOUNT OF FINISH-A AMOUNT OF FINISH-R
2 FACE MILL ZY ◆ 90. 30. 1 ◆ 0. ◆
SNo. TOOL NOMINAL DIAMETER APPROACH 1 APPROACH 2 METHOD AFD NOTCH-A NOTCH-R PERIPH-ERAL SPEED FEED M M
R 1 FACEMILL ◆
FIG SHAPE SURFACE SHIFT R Z Y RADIUS R/Q I J P CORNER ROUGHNESS
1 LINE 10. 0. 10. ◆
2 LINE ◆ 40. 10. ◆
3 LINE ◆ 40. -10. ◆
4 LINE ◆ 0. -10. ◆
UNo.UNIT MODE ANGLE B POSITION C MACHINING ALLOWANCE-A BOTTOM WALL AMOUNT OF FINISH-A AMOUNT OF FINISH-R
3 FACE MILL ZY ◆ 90. 30. 1 ◆ 0. ◆
SNo. TOOL NOMINAL DIAMETER APPROACH 1 APPROACH 2 METHOD AFD NOTCH-A NOTCH-R PERIPH-ERAL SPEED FEED M M
R 1 FACEMILL ◆
FIG SHAPE SURFACE SHIFT R Z Y RADIUS R/Q I J P CORNER ROUGHNESS
1 LINE 10. 0. 10. ◆
2 LINE ◆ 40. 10. ◆
3 LINE ◆ 40. -10. ◆
4 LINE ◆ 0. -10. ◆
UNo.UNIT MODE ANGLE B POSITION C MACHINING ALLOWANCE-A BOTTOM WALL AMOUNT OF FINISH-A AMOUNT OF FINISH-R
3 FACE MILL ZY ◆ 90. 30. 1 ◆ 0. ◆
SNo. TOOL NOMINAL DIAMETER APPROACH 1 APPROACH 2 METHOD AFD NOTCH-A NOTCH-R PERIPH-ERAL SPEED FEED M M
87
91

FIG.50

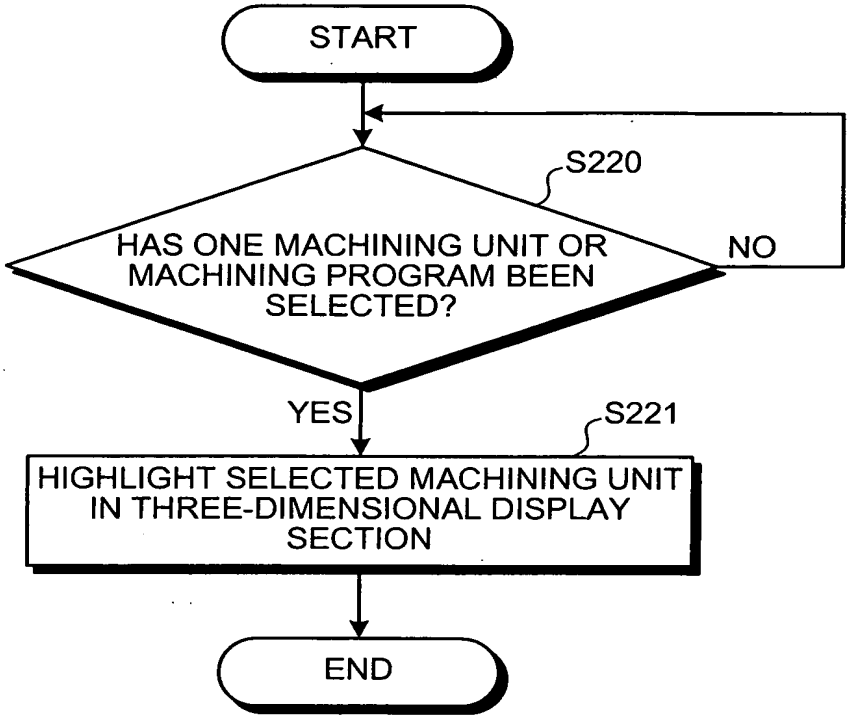



FIG.51A

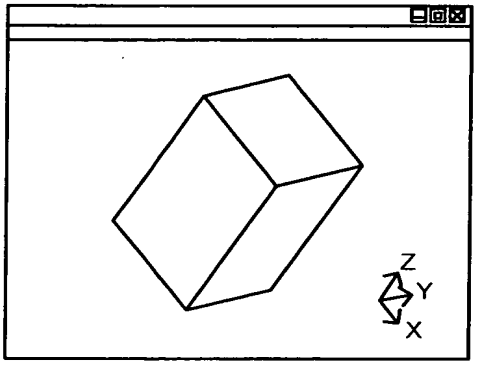



FIG.51B

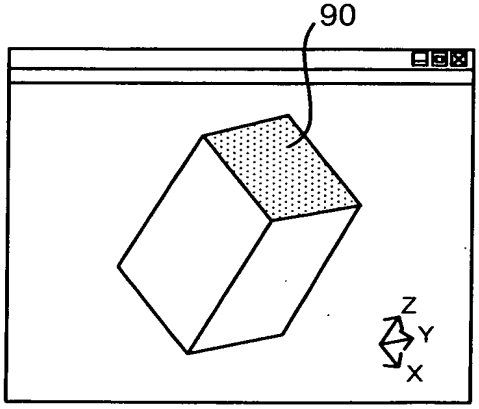


FIG.52

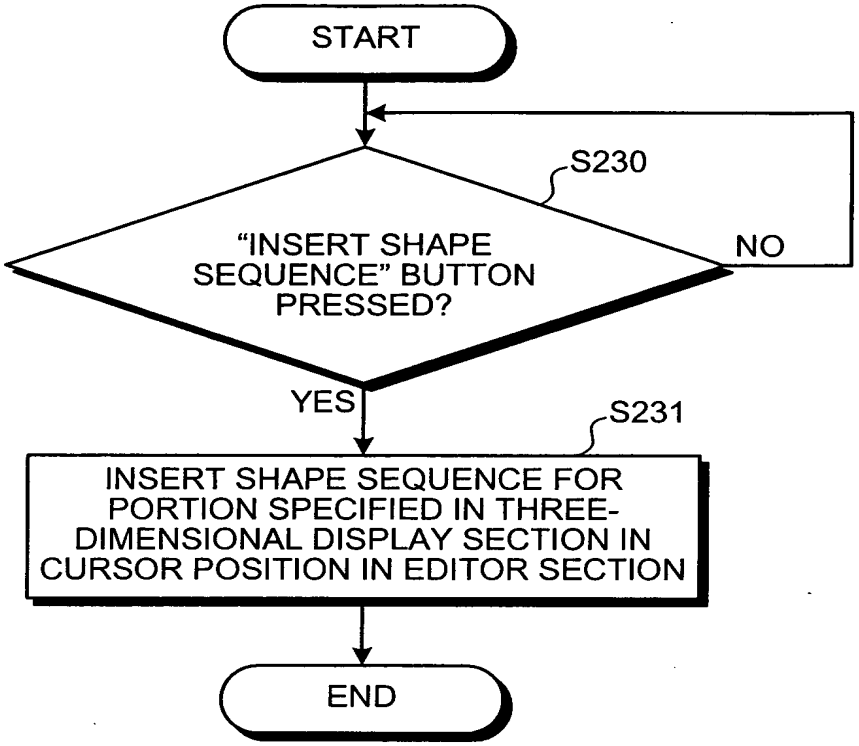

START
S230
"INSERT SHAPE SEQUENCE" BUTTON PRESSED?
NO
YES
S231
INSERT SHAPE SEQUENCE FOR PORTION SPECIFIED IN THREE-DIMENSIONAL DISPLAY SECTION IN CURSOR POSITION IN EDITOR SECTION
END

FIG.53

| UNIT INEXPANDABLE | | MODE /Y | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FIG | SHAPE | SURFACE SHIFT Z | SURFACE SHIFT R | X | Y | RADIUS R/ | I | J | ANGLE B | ANGLE C |
| 1 | LINE (SUPPORT) | 0 | 0 | 18.487 | -29.602 | | | | 0 | 0 |
| 2 | LINE | ◆ | ◆ | 18.487 | -18.5 | | | | ◆ | ◆ |
| 3 | LINE | ◆ | ◆ | -18.487 | -18.5 | | | | ◆ | ◆ |
| 4 | LINE | ◆ | ◆ | -18.487 | -29.602 | | | | ◆ | ◆ |
| 5 | LINE | ◆ | ◆ | 18.487 | -29.602 | | | | ◆ | ◆ |

FIG.54

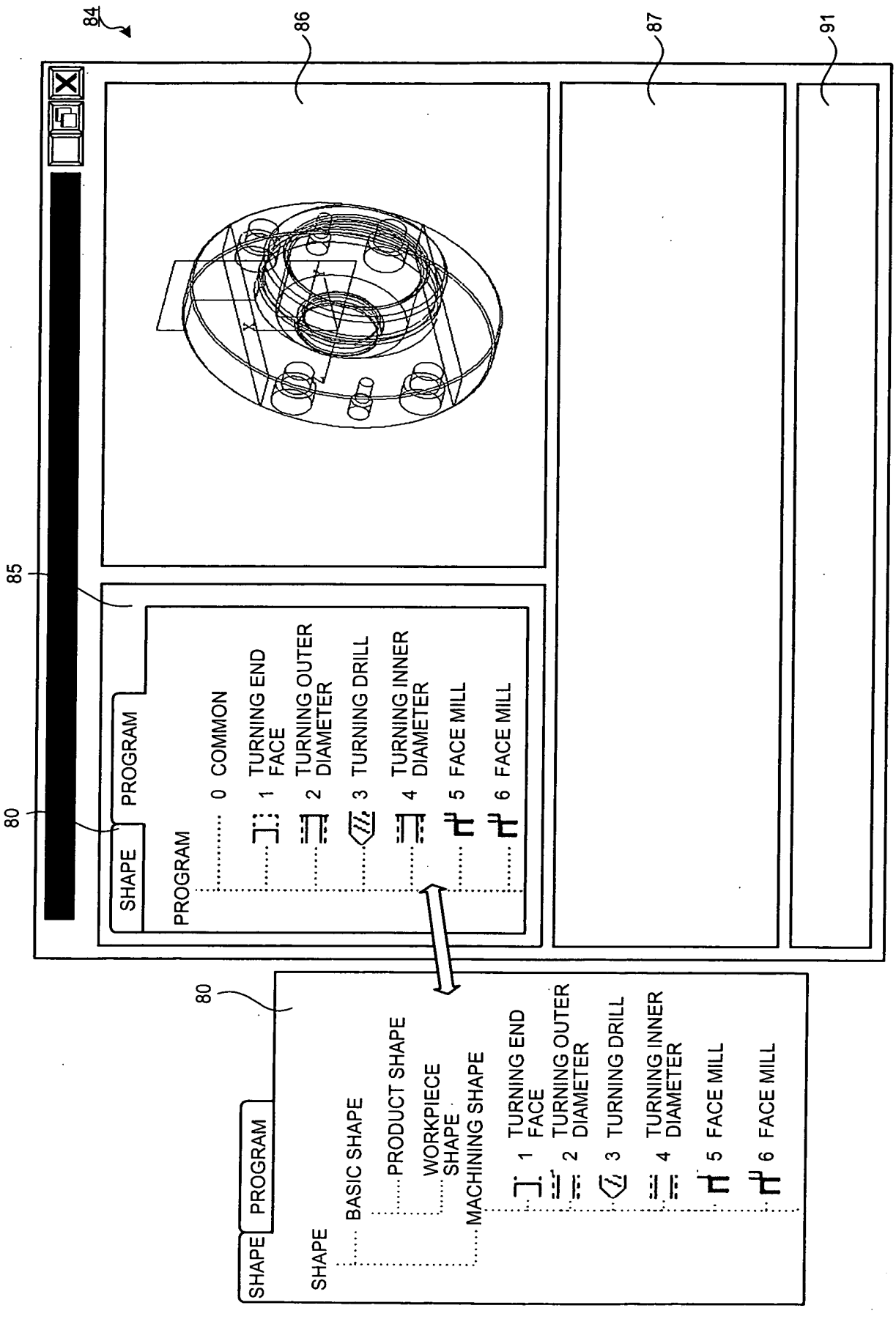

84
86
87
91
85
80
SHAPE
PROGRAM
PROGRAM
0 COMMON
1 TURNING END FACE
2 TURNING OUTER DIAMETER
3 TURNING DRILL
4 TURNING INNER DIAMETER
5 FACE MILL
6 FACE MILL
80
SHAPE
PROGRAM
SHAPE
BASIC SHAPE
PRODUCT SHAPE
WORKPIECE SHAPE
MACHINING SHAPE
1 TURNING END FACE
2 TURNING OUTER DIAMETER
3 TURNING DRILL
4 TURNING INNER DIAMETER
5 FACE MILL
6 FACE MILL

FIG.55

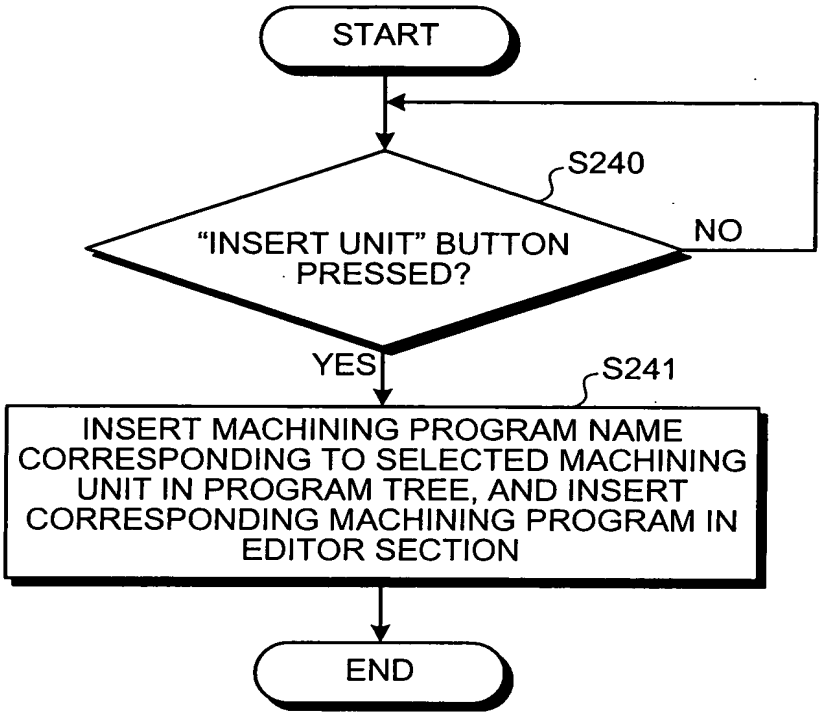

START
S240
"INSERT UNIT" BUTTON PRESSED?
NO
YES
S241
INSERT MACHINING PROGRAM NAME CORRESPONDING TO SELECTED MACHINING UNIT IN PROGRAM TREE, AND INSERT CORRESPONDING MACHINING PROGRAM IN EDITOR SECTION
END

FIG.56

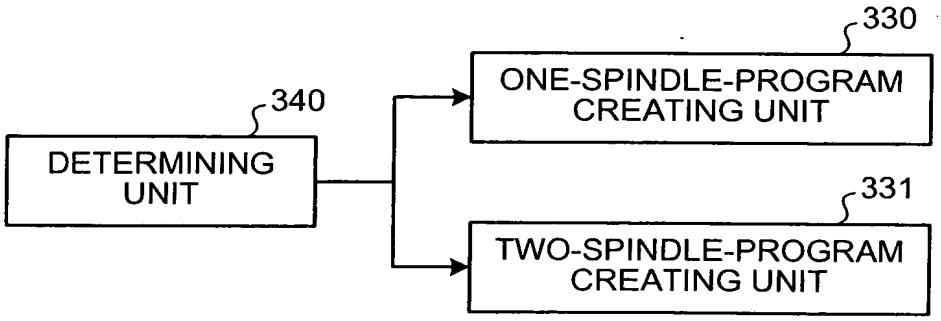
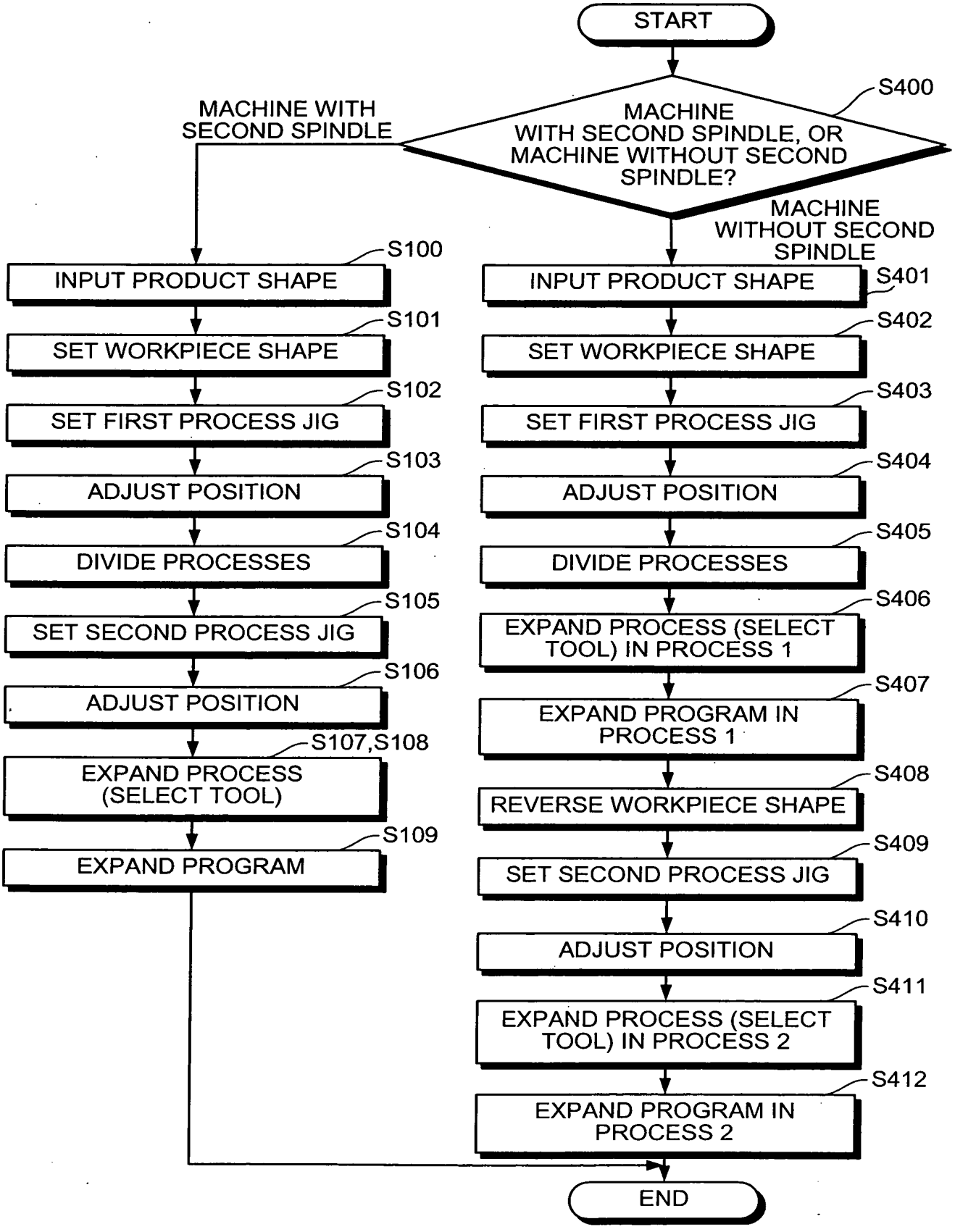

330
ONE-SPINDLE-PROGRAM CREATING UNIT
340
DETERMINING UNIT
331
TWO-SPINDLE-PROGRAM CREATING UNIT

FIG.57


START
S400
MACHINE WITH SECOND SPINDLE, OR MACHINE WITHOUT SECOND SPINDLE?
MACHINE WITH SECOND SPINDLE
MACHINE WITHOUT SECOND SPINDLE
S100
INPUT PRODUCT SHAPE
S101
SET WORKPIECE SHAPE
S102
SET FIRST PROCESS JIG
S103
ADJUST POSITION
S104
DIVIDE PROCESSES
S105
SET SECOND PROCESS JIG
S106
ADJUST POSITION
S107,S108
EXPAND PROCESS (SELECT TOOL)
S109
EXPAND PROGRAM
S401
INPUT PRODUCT SHAPE
S402
SET WORKPIECE SHAPE
S403
SET FIRST PROCESS JIG
S404
ADJUST POSITION
S405
DIVIDE PROCESSES
S406
EXPAND PROCESS (SELECT TOOL) IN PROCESS 1
S407
EXPAND PROGRAM IN PROCESS 1
S408
REVERSE WORKPIECE SHAPE
S409
SET SECOND PROCESS JIG
S410
ADJUST POSITION
S411
EXPAND PROCESS (SELECT TOOL) IN PROCESS 2
S412
EXPAND PROGRAM IN PROCESS 2
END